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Estech General Chemicals Corporation, Duette Mine Manatee County, Florida. Resource Document Reclamation Methodology

Zellars-Williams, Inc, Lakeland, FL

Prepared for

Conservation Consultants, Inc, Palmetto, FL

Oct 79

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United States
Environmental Protection
Agency

Region 4
345 Courtland Street, NE
Atlanta, GA 30308

EPA 904/9-79-044F
October 1979

EPA Environmental Impact Statement

DRAFT

Estech General Chemicals Corporation
Duette Mine
Manatee County, Florida

RECLAMATION METHODOLOGY

RESOURCE DOCUMENT

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The Draft Environmental Impact Statement for the Estech General Chemicals (formerly Swift Agricultural Chemical) Duette Mine is enclosed for your review and comment. The document has been prepared pursuant to Section 102(2)(c) of the National Environmental Policy Act (NEPA) (Public Law 91-190) and applicable EPA regulations at 40 CFR Part 6.9. Thirteen volumes of resource document were also prepared. These resource documents comprise the detailed technical evaluations of the alternatives and the proposed action and contain supporting data related to the Draft EIS. While the Draft EIS isa complete document.

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RECLAMATION METHODOLOGY

RESOURCE DOCUMENT

Draft Environmental Impact Statement

Swift Agricultural Chemicals Corporation
Duette Mine Site
Manatee County, Florida

October, 1979

Prepared For: U. S. ENVIRONMENTAL PROTECTION AGENCY
Region IV
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FOREWARD

The following Reclamation Methodology Resource Document describes procedures and methodologies developed by Swift Agricultural Chemicals Corporation for presentation to Regional and Local Regulatory Agencies. The material herein draws heavily upon the Master Mining Plan (MMP) submitted to Manatee County and the Development of Regional Impact (DRI) Application for Development Approval filed with the Tampa Bay Regional Planning Council as part of the local and regional approval procedure. Revisions and additions resulting from the review of these agencies have been incorporated into this Reclamation Methodology Resource Document.

RECLAMATION METHODOLOGY
RESOURCE DOCUMENT

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NOTE:

Effective August 1, 1979, Swift Agricultural Chemicals Corporation changed its name to Estech General Chemicals Corporation.

The preparation of the Draft Environmental Impact Statement was substantially completed at the time of the name change. Therefore, the name of Swift Agricultural Chemicals Corporation (Swift) is used throughout the Draft Environmental Impact Statement and all attendant Resource Documents.

RECLAMATION METHODOLOGY

1. INTRODUCTION

The Swift Duette Mine site is in the northeastern portion of Manatee County, a rural area with agriculture as the principal economic base. The topography of the tract is relatively flat. Gradients are less than 10 feet per mile except where streams dissect the property. Slope trends southwestward (Figure 1-1). The 10,394 acre site is divided into three drainage basins providing drainage to the Manatee River, Little Manatee River, and Myakka River.

The site is located approximately 10 miles upstream of Lake Manatee and comprises 11.6 percent of the total watershed area of this reservoir.

Seven natural vegetation associations are found on the Swift property. These are: Sand Pine Scrub, Xeric Oak, Longleaf Pine-Xeric Oak, Longleaf Pine Flatwoods, Cypress, Freshwater Swamp, and Freshwater Marsh (Figure 1-2). Ruderal, or ecologically disturbed habitats include improved pasture, citrus grove, and vegetable field. Ruderal areas support a wide variety of both native and exotic species. Ruderal areas make up 2,257 acres of the Swift property.

Current land uses will be affected to various degrees by the

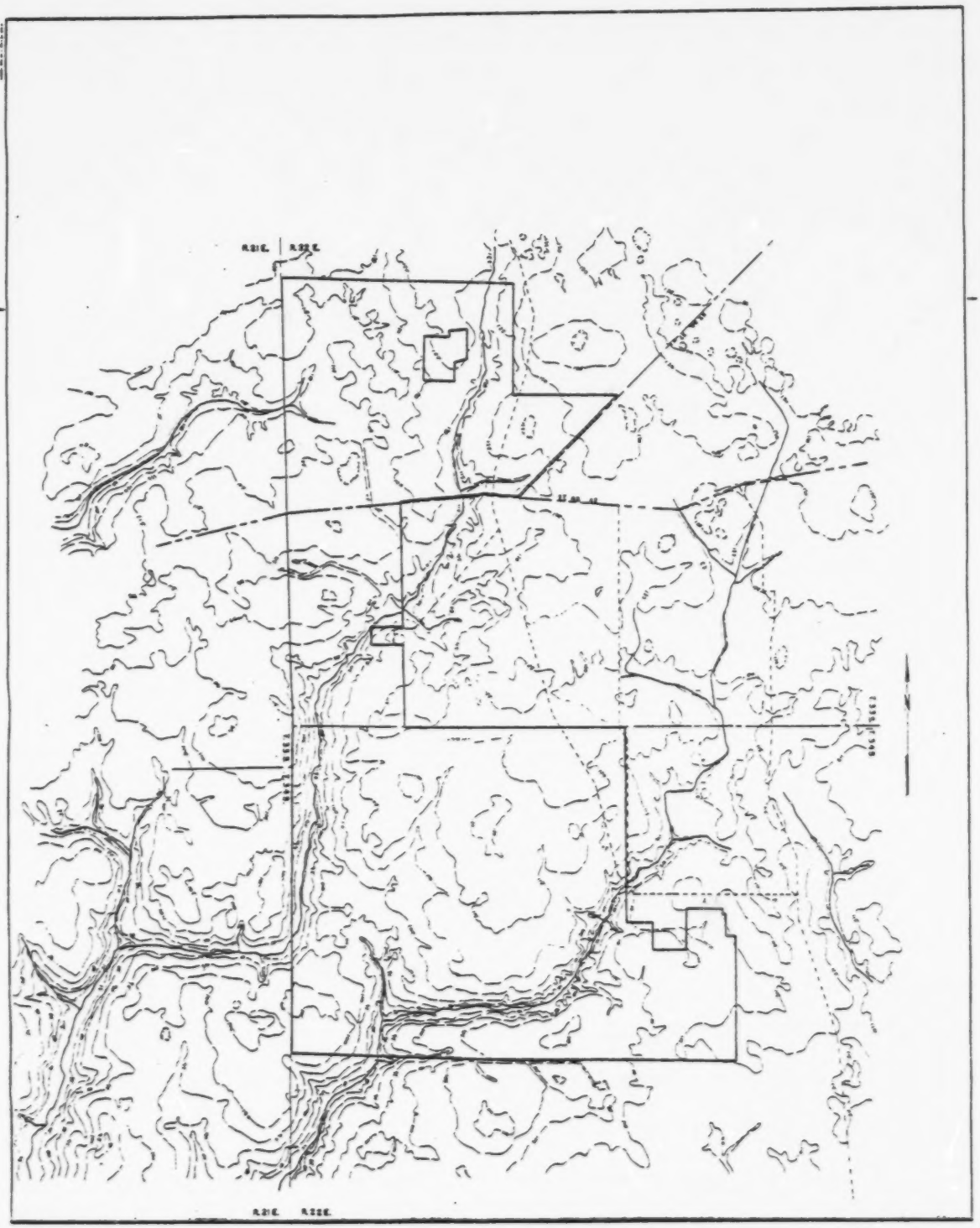

FIGURE 1-1

EXISTING TOPOGRAPHY

Source: Ardaman and Associates, Inc.

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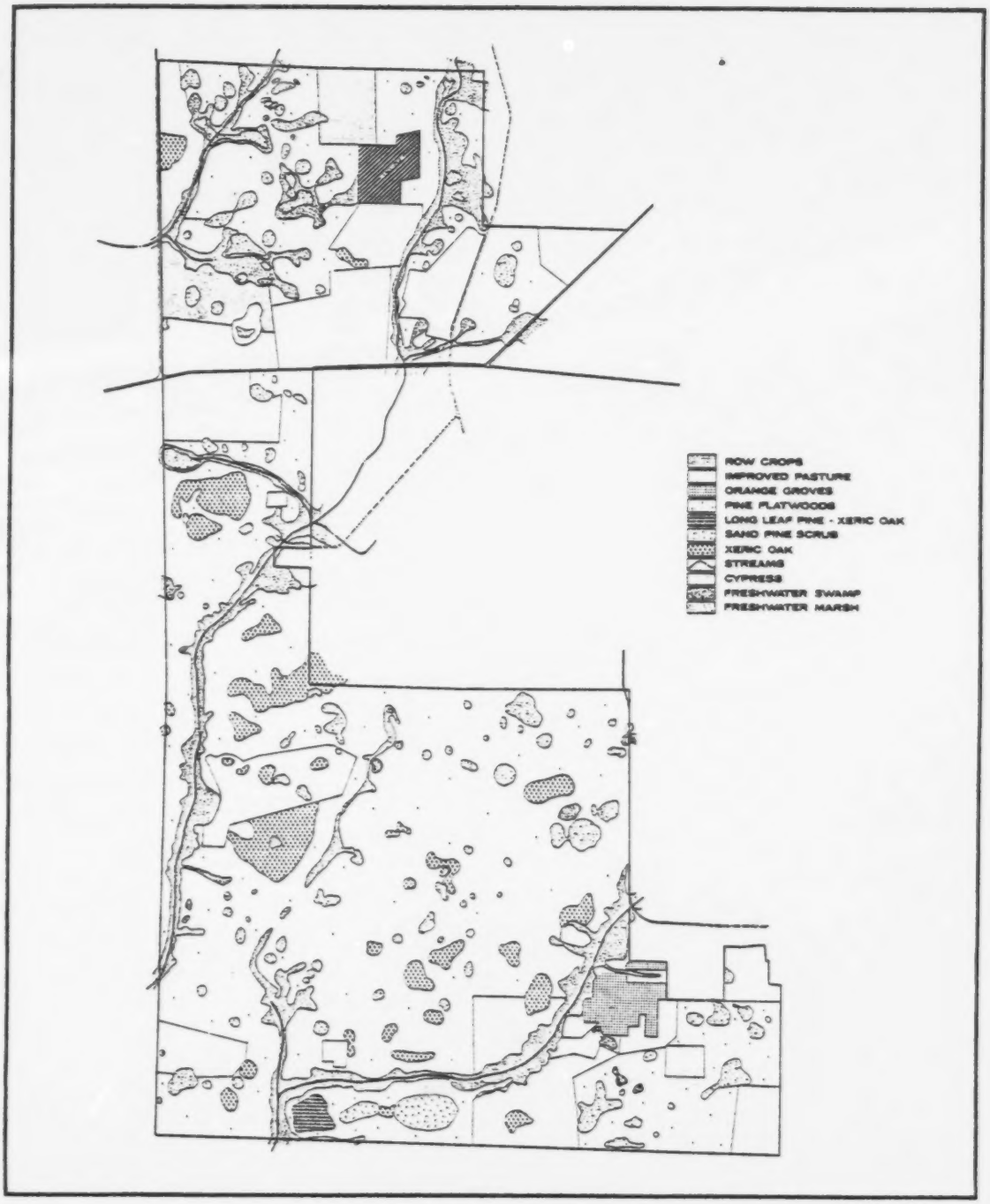

FIGURE 1-2

VEGETATION

Source: Conservation Consultants, Inc.

U.S. EPA - REGION IV
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IMPACT STATEMENT FOR
SWIFT AGRICULTURAL CHEMICALS
CORPORATION PROPOSED
DUETTE MINE
MANATEE COUNTY, FLORIDA

mining operation. Table 1-A lists existing land use acreages and percent alterations.

2. RECLAMATION OBJECTIVES

Local long-range plans call for the eastern portion of Manatee County to remain rural in nature with agriculture as the primary economic base. The reclamation plan for the Swift mining tract was developed upon this premise.

The overall goal of the reclamation plan for the Duette Mine is to maintain or improve upon existing economic productivity and value while sustaining important environmental functions. Mining and reclamation are interrelated in both the planning and operational phases. Prior to the development of the mining and reclamation plans, an investigation into the site characteristics, ore deposits, dragline movements, backfill constituency and deposition, drainage, environmental value, and economic productivity was completed (Zellars-Williams, Inc., 1978). This evaluation resulted in the foregoing reclamation plan.

The majority of reclaimed land will initially be utilized as improved pasture. This use should be regarded as a means of encouraging the development of soil organic matter and thereby improving the land for future potential uses. Potential, future agricultural uses for reclaimed land other than pasture will

TABLE 1-A LAND USE CLASSIFICATION

LAND USE CLASSIFICATION

Phase	132 A	132 %	211 A	211 %	213 A	213 %	231 A	231 %	411 A	411 %	412 A	412 %	413 A	413 %	421 A	421 %	521 A	521 %	611 A	611 %	621 A	621 %	641 A	641 %	751 A	751 %	755 A	755 %	760 A	760 %	431 A	431 %
Present *	0	0	467	4.5	1,677	16.1	113	1.1	5,673	54.6	35	0.3	73	0.7	518	5.0	0	0.0	18	0.2	1,218	11.7	600	5.8	0	0.0	0	0.0	0	0.0	0	0.0
Pre Mining (2 yrs)	186	1.8	467	4.5	1,677	16.1	113	1.1	5,118	49.2	35	0.3	73	0.7	419	4.0	24	0.2	18	0.2	1,208	11.6	575	5.5	0	0.0	0	0.0	480	4.6	0	0.0
Mining (1-4)	186	1.8	467	4.5	1,732	16.7	113	1.1	4,024	38.7	35	0.3	73	0.7	324	3.1	184	1.8	18	0.2	1,156	11.1	494	4.8	1,107	10.7	0	0.0	480	4.6	0	0.0
Mining (5-8)	186	1.8	467	4.5	2,331	22.4	25	0.2	3,199	0.8	35	0.3	73	0.7	218	2.1	184	1.8	18	0.2	1,051	10.1	514	4.9	1,604	15.4	0	0.0	480	4.6	8	0.1
Mining (9-12)	186	1.8	294	2.8	3,518	33.9	25	0.2	2,496	24.0	35	0.3	73	0.7	179	1.7	184	1.8	18	0.2	1,039	10.0	590	5.7	1,254	12.1	0	0.0	480	4.6	21	0.2
Mining (13-16)	186	1.8	227	2.2	4,461	44.1	25	0.2	1,524	14.7	35	0.3	73	0.7	136	1.3	184	1.8	18	0.2	1,093	9.3	661	6.4	1,258	12.1	0	0.0	480	4.6	32	0.3
Mining (17-20)	186	1.8	116	1.1	5,249	51.7	25	0.2	954	9.2	35	0.3	73	0.7	98	0.9	184	1.8	18	0.7	922	7.7	685	6.6	1,275	12.8	100	1.0	480	4.6	43	0.4
Mining (21)	186	1.8	106	1.0	5,460	53.7	25	0.2	829	8.0	0	0.0	50	0.5	89	0.9	184	1.8	18	0.2	922	7.7	714	6.9	1,184	11.4	100	1.0	480	4.6	46	0.4
Post Mining (22-25)	0	0.0	106	1.0	6,162	63.4	25	0.2	829	8.0	0	0.0	50	0.5	89	0.9	384	3.7	18	0.2	1,228	7.7	864	8.3	0	0.0	100	1.0	480	4.6	58	0.6
Post Mining (26-31)	0	0.0	106	1.0	6,642	68.0	25	0.2	829	8.0	0	0.0	50	0.5	89	0.9	384	3.7	18	0.2	1,228	7.7	864	8.3	0	0.0	100	1.0	0	0.0	58	0.6

Classification:

132	– Heavy industrial (Plant site and railroad)	431	– Mixed forest
211	– Row crops	521	– Lakes
213	– Improved pasture	611	– Cypress
231	– Orange Grove	621	– Freshwater swamp
411	– Pine flatwoods, palmetto range	641	– Freshwater marsh
412	– Longleaf pine, xeric oak	751	– Mineral extraction
413	– Sand pine scrub	755	– Abandoned mining operations (wilderness area)
421	– Xeric oak forest	760	– Other barren lands (clay settling pond)

* All acreage is approximate and is given for those areas existing at the end of the phase indicated.

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include row cropping, citrus, and silviculture. Both vegetable farming and citrus may benefit from the ready availability of irrigation water in reclamation lakes. Silviculture should be possible on all reclaimed soils with the possible exception of the clay settling area. Because of the poor physical properties of the clay soil, the settling area will probably be left in improved pasture for the foreseeable future, although it is possible that cultivation of this fertile soil will become feasible as soil organic matter builds up.

In addition to the areas devoted to agricultural production, there will be substantial areas devoted to environmental functions. The mining plan excludes from disturbance many areas of substantial environmental value. Using these preservation areas as a base, the reclamation plan will seek to restore other important environmental functions now performed by the tract. Of prime consideration will be the site's function as an integral part of the Manatee River watershed. Much of the East and North Forks of the River will be maintained. A portion of the East Fork Manatee River is included in the mining plan. In this case, a major restoration effort is proposed to create a new streambed and floodplain, and to re-establish wetland vegetation prior to disturbance of the natural stream.

Marsh establishment in the reclamation plan will consist of construction of several hundred acres of shallow depressions. The unassisted development of marsh-type habitats, along with the preserved natural wetlands, will serve as filtration and

nutrient assimilation areas for cattle wastes and other agricultural run-off and thereby mitigate adverse effects associated with enhanced agricultural activity on the site.

The reclamation plan also provides for other important environmental functions of the site. Reclaimed lakes formed in reclamation will add sport fishing potential and serve as habitat for aquatic birds in addition to their water storage function. The preservation or restoration of wooded floodplain areas will maintain one of the more important wildlife habitats on the site. Artificial marshes, plantings of native tree strands, and a designated wilderness area will provide additional habitats for a wide variety of wildlife.

The following section of the reclamation plan contains an explanation of the physical methodology for land restoration. Subsequent sections deal with vegetative restoration and land use plans for the reclaimed site.

3. PHYSICAL METHODOLOGY

Reclamation is accomplished by the physical restructuring and refilling of the disturbed sites followed by the revegetation of these sites. The actual process is multi-disciplinary in that the earthmoving and revegetation must be coordinated with the intended environmental concepts and the land use objectives. These determine not only the method of restoration but also the

location and timing for individual sites.

During the life of the operation, the following six types of reclamation will be involved:

- o Sand-clay landfill
- o Sand-tailings landfill with an overburden cap
- o Clay settling area
- o Lake areas
- o Wilderness area
- o Plant site

3.1 Sand-Clay Landfill

Sand-clay landfill was chosen as the primary reclamation technique to reduce the need for conventional clay settling areas. It is proposed that most of the mined area will be refilled using a mixture of the clay and sand tailings by-products. The method by which the sand and clays are mixed has been the subject of applied research by the Florida Phosphate Industry and government agencies for a number of years. The present state of the art considers several methodologies including:

- o Intermittent spraying of sand tailings over clay filled areas with periods of settling and mixture.
- o Flocculation or chemically induced thickening of clays prior to addition of the sand to improve settling and mixing at the disposal site.
- o Pumping of sand tailings into or over active or

previous filled clay areas to improve stabilization and provide a mixture heterogeneous in physical and soil properties.

Swift plans to continue studies aimed at determining the best method for the Duette Mine. The relatively low clay content of the ore in Manatee County presents an excellent potential for success in producing a feasible and economic method.

The Swift reclamation plan proposes the refilling methodologies presented in Figure 3.1-1. The final topography, as shown in Figure 3.1-2, will result from the restructing and filling of the site. The following sequence will be incorporated in the sand-clay filling procedure.

a) Levees will be constructed around the perimeter of each mined area, designated for sand-clay fill. The size of each area will be determined by the required retention time for water clarification, reclamation schedule, and availability of fill materials versus mining advancement. The levees will be constructed from perimeter spoil windrows (overburden). The plan contained herein calls for an average levee height of 14 feet above original grade. The slope of the levee will be determined by a soil engineer in consideration of construction safety factors. The levees will have an extremely wide cross section and will form a retaining system that is

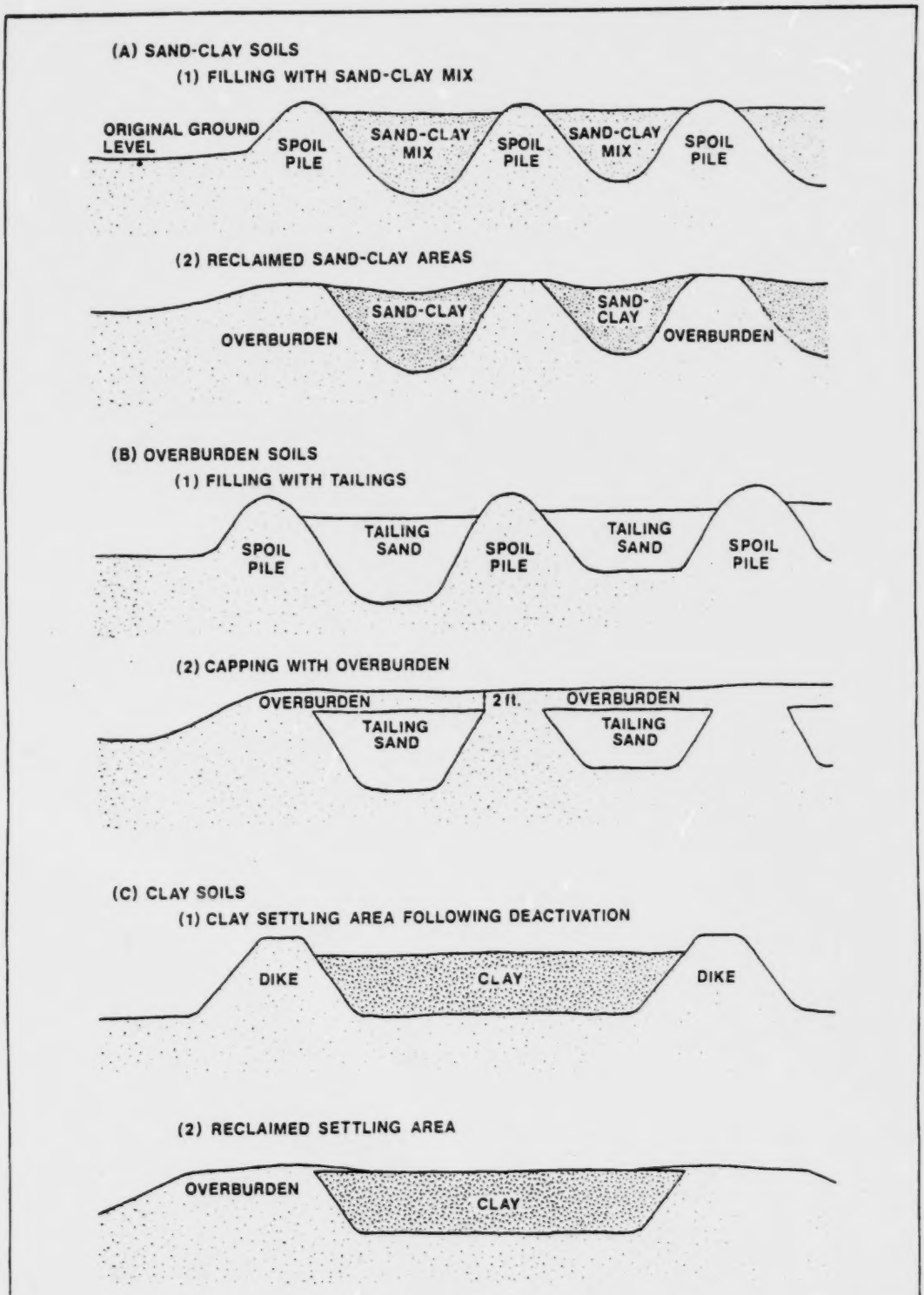

FIGURE 3.1-1 (A) (B) (C)

BACKFILL METHODOLOGY

Source: Zellars-Williams, Inc.

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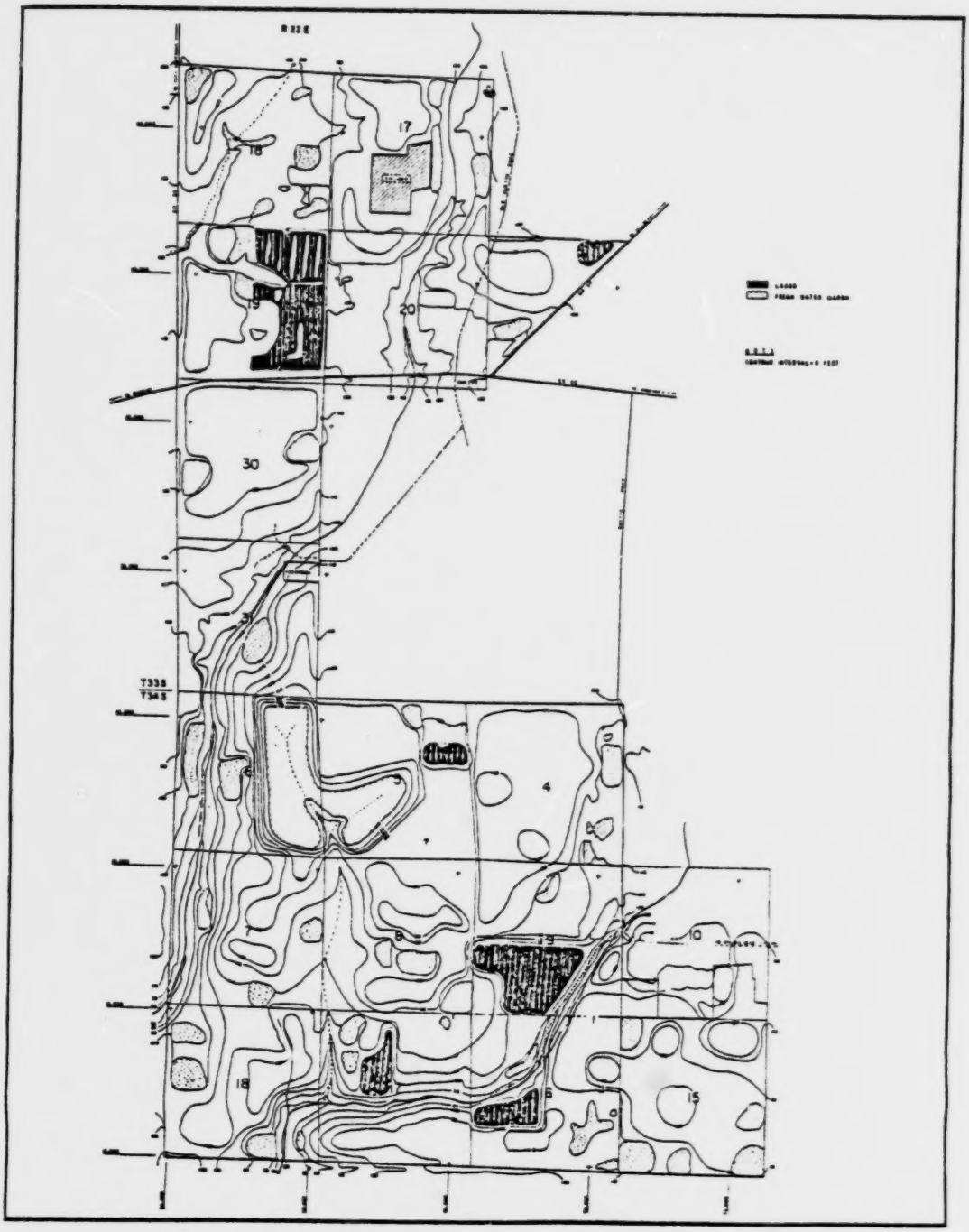

FIGURE 3.1-2

FINAL TOPOGRAPHY

Source: Zellars-Williams, Inc.

U.S. EPA-REGION IV
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SWIFT AGRICULTURAL CHEMICAL
CORPORATION PROPOSED
DUETTE MINE
MANATEE COUNTY, FLORIDA

desirable from the aspects of aesthetics, safety, and amenability to final reclamation.

b) It is planned for the interior to be filled with the sand-clay fill to an average height of nine feet above original grade and a minimum of five feet below the levee top. The filling above ground is necessary to allow for initial subsidence of the material as it dewaters and subsequent subsidence as it continues to stabilize in the years to follow. Initially, the mixture will be 12 to 15 percent solids. Within a short time, it will reach about 30 percent solids which is sufficient to support machinery necessary to complete the reclamation process.

c) The dewatering of the mixture will be induced by continuing to drain water from the top of the sand-clay fill material and allowing its settlement. The filling-decantation process may be repeated in an area to maximize compaction.

d) Once the desired elevation of consolidated sand-clay mixture is attained, the levees and any protruding spoils will be graded to conform to slope requirements for both the interior and exterior of the site.

On the average, two years will be allowed to fill a given levee. An additional two years will be allotted to drying and

consolidation of the reclamation block. Final grading and revegetation will require an additional year giving a reclamation block time of five years. The individual parcels will vary in size and shape but will generally be smaller than typical clay settling areas.

Sand and clay mixed during the waste disposal process in the approximate ration of 2.5:1 will be the predominant post-mining soil. This soil will occupy 5,426 acres or 52.2 percent of the mine site. Texturally, this soil would be classified as a sandy loam and should be a productive soil. Its content of silt and clay gives it water and nutrient retention properties. The apatite, dolomite, and feldspar contents of the silt and clay give it natural fertility. The sand content should ameliorate tillage and aeration problems associated with clay soils.

The final drainage system will be controlled by the elevation of the drainage outfall in the form of fixed structures (pipes) or grading, packing, and sodding of the earthen levees. The purpose of such drainage impediment is to allow the formation of marshes near the drainage outfall area (see marsh restoration) and control final water table elevation. A cross section showing the sequence of the sand-clay filling-regrading process is shown in Figure 3.1-1.

3.2 Sand-tailings Fill

The filling of mined out areas with waste sand-tailings is a method of land restoration commonly employed by the Florida

phosphate industry. It consists of hydraulically transporting the tailings sand from the beneficiation plant into mine pits. The fill level is predetermined based on surface drainage requirements and desired water table re-establishment. Once the tailings are spread to the desired grade, it is common practice to top or cover them with overburden material from protruding piles or from the mined area's perimeter. The overburden is commonly spread by pans and/or tractors to an average depth of 2 feet. Tailings sand normally has excellent bearing capacity and, therefore, spreading of the overburden can proceed almost immediately after the filling is complete. Top spreading of the overburden is for the purpose of providing a soil cover of improved agricultural characteristics to that of the relatively infertile tailings sand. A cross section diagram of the physical restoration of tailings filled areas is shown on Figure 3.1-1.

Overburden soils resulting from the capping of tailings landfills will occupy 848 acres or 8.2 percent of the site after mining. Overburden is typically higher in clay and nutrients, particularly P and Ca, than native surface soils. Hence, while not as fertile as the sand-clay soils, overburden soils should equal native soils in productivity.

3.3 Clay Settling Area

Clay soils resulting from the reclamation of the 480 acre clay settling area will account for 4.6 percent of the site. This soil will be fertile and have good water and nutrient retention

properties. However, tillage properties and soil aeration will be poor until soil organic matter builds up and provides some degree of soil structure.

A crust development technique will be used to reclaim the above grade clay settling area. At completion of mining operations, the area will have been filled with phosphatic clays. These clays will have a retained moisture in the range of 75-85 percent and have extremely low bearing capacity, insufficient to support reclamation machinery. To improve the soil stability, ditches will be dug within the perimeter of the settling area to induce drainage and release moisture from the uppermost material. Such drainage and drying will induce subsidence of the clay and improve soil strength. As stabilization occurs, more interior ditches will be cut using small draglines or low ground pressure vehicles. The subsidence and crust development of the clay settling area will require a period of several years to accomplish. Rotovators, wide track bulldozers, mowers, etc. will continue to clear and ditch the area to further induce drying when the crust will support agricultural machinery. Once the clay has subsided to the desired level and has sufficient bearing strength, the exterior retaining dike will be pushed towards and away from the settling area to establish a lower grade slope and provide some coarser textured material for the interior soils of the settling area as shown on Figure 3.1-1.

Upon completion of mining operations, the plant and railroad will be dismantled and useable materials salvaged. Unsalvageable

materials such as concrete, asphalt, etc. will be used as landfill. Power lines and pipelines will also be dismantled and removed from the site. The surface soil will be graded, disked, and grassed. Two years will be allotted to dismantling of the plant and an additional year for establishment of a vegetative cover.

3.4 Lake Areas

Five lakes will be created during reclamation, representing 474 acres. Selected mine pits resulting from removal of phosphate matrix will be used to form lakes by grading of interior spoil windrows to an elevation expected to be six feet below the re-established water level. Shoreline contours are addressed in Section V. These lakes will be located on the site so as to serve adjoining land from the standpoint of their aesthetic, wildlife and irrigation water values. A few islands (spoil peaks) will be left in most lakes to serve as habitat for aquatic birds and waterfowl.

3.5 Wilderness Area

In the northeast corner of Section 19, a 100-acre wilderness area will be allowed to develop. The only physical reclamation of this area will be the topping and separation of the spoil pile peninsulas from the adjacent land, thereby creating rows of islands with limited accessibility to man.

3.6 Plant Site

In all types of reclamation, erosion and turbid run-off will

be controlled. In particularly sensitive areas, such as those in close proximity to creeks, final grading and seeding will not be attempted during the summer rainy season. Instead, these projects will be undertaken during the spring and fall months when heavy rains are rare. It is recognized that this timing will necessitate supplemental irrigation in order to establish a vegetative cover before the onset of the rainy season.

Figure 3.1-2 presents the final topography resulting from the restructuring and refilling of the site.

4. GENERAL REVEGETATION METHODOLOGY

4.1 Improved Pasture

Past experience by the industry has shown that overburden and clay soils will support improved pasture. Data developed by Swift provides evidence that sand-clay soils will be even better for this purpose (Zellars-Williams, Inc., 1978).

Coastal Bermudagrass was selected as the permanent grass for planting on sand-clay soils. This grass has the ability to make high production of forage on fertile soils. This grass was also selected for planting on the portions of the clay settling area that have good surface drainage. Plans call for establishing poorly drained areas in Pensacola Bahiagrass which is adaptable to such conditions. Pensacola Bahiagrass will also be planted on the overburden soils over sand tailings fill. This grass,

while not generally as productive as Coastal Bermuda, will make good production on soils with the moderate fertility of overburden.

Overseeding permanent grasses with legumes is also intended in the reclamation plan. White clover was selected for overseeding on clay and sand-clay soils. This legume favors a soil with high levels of plant available Ca, Mg and P and a pH near neutrality. Moreover, in the absence of irrigation, it requires a soil with good water holding capacity. Reclaimed clay and sand-clay soils on the Duette Mine site will meet these criteria. Reclaimed clay settling areas in Polk and Hillsborough Counties have produced excellent white clover forage without supplemental irrigation. While sand-clay soils will not equal clay soils with respect to fertility or water holding capacity, they are expected to be adequate for the production of white clover. Overburden soils will be overseeded with either aeschynomene (jointvetch) or hairy indigo. These legumes have readily established on reclaimed overburden soils in the traditional mining areas of central Florida.

The inclusion of legumes in the pasture sods established on reclaimed land is intended to eliminate the need for nitrogen fertilization. Since phosphorus is generally adequate on all reclaimed phosphate lands, potassium will be the only major element required in fertilization programs. Past experience on clay soils in mining areas, as well as preliminary studies of clays on the Duette Mine tract, indicate that potassium may

be adequate in clay and sand-clay soils. Plant available potassium is apparently due to the presence of potassium feldspars in the clay fraction. Hence, it is likely that reclaimed pastures on the tract can be maintained at a high level of productivity with a low level of fertilizer input.

4.2 Reforestation

The proposed reforestation effort is directed primarily at the goal of providing aesthetic appeal, cattle shade, and habitat for wildlife.

Plantings of native plant species near artifical marshes will be made in strands approximately 150 feet by 1,000 feet at a density of 60 per acre. Such strands are proposed within each section (640 acres) of reclaimed pasture land. Water oak, laurel oak, live oak, sweetgum, longleaf pine, slash pine, saw palmetto, wax myrtle and gopher apple are proposed to be included in each strand. Oaks, sweetgums and pines of 2-4 inch diameter will be transplanted with a tree spade from areas that are to be mined. Additional seedlings will be obtained from the Florida Forest Service for planting. These species will provide the mixed forest overstory while the palmetto, wax myrtle and gopher apple will constitute the understory. Native plantings will be fenced for the first years following reclamation to protect them from cattle until they become firmly established.

Another type of planned reforestation in improved pasture is

eucalyptus plantings to provide cattle shade during the period of native planting establishment. Cluster plantings, approximately three acres in size, will be made at a density of 100 trees per acre using potted seedlings obtained from the Forest Service. Two clusters are planned for each section of reclaimed pasture. Two species will be planted Eucalyptus robusta and Eucalyptus camaldulensis. Eucalyptus robusta was selected because it is an excellent shade tree with a rough bark that resists rubbing by livestock. Eucalyptus camaldulensis was selected for its cold tolerence, although it provides less shade than Eucalyptus robusta. Both eucalyptus are faster growing than the native species and hence can be expected to provide shade at an earlier date. When the native plantings are sufficiently established to provide cattle shade, the eucalypts can be harvested for pulpwood if so desired.

4.3 Enhancement Of Unmined Palmetto Rangeland

Plans call for a reforestation effort on previously cut-over pine flatwoods not disturbed by the mining operation. Approximately 829 acres of cut-over flatwoods will be planted with slash pine seedlings. These plantings will be made at a spacing of 8 feet by 12 feet, or roughly half the normal commercial density in order to prevent shading of understory species. The primary purpose of these plantings will be to restore cover and feeding grounds for wildlife.

4.4 Marsh Revegetation

The reclamation plan calls for the construction of 538 acres of shallow depressions in sand-clay landfills and an additional 90 acres of littoral zone within four reclaimed lakes. Plans presently intend to allow these areas to revegetate naturally. Marsh type vegetation has volunteered in similar, shallow aquatic environments left by mining. It is expected that these areas will be colonized largely by cattails in the deeper portions with pasture grasses, broomsedge, and various sedges along the edges.

5. SPECIAL CASE RECLAMATION METHODOLOGY

5.1 Wetland Restoration

The reclamation plan specifically provides for wetland restoration projects of three basic types:

Restoration of a three-quarter mile section of the East Fork Manatee River together with its associated floodplain and swamp-type vegetation.

Creation of shallow depressions in sand-clay landfills and shallow lake zones to encourage establishment of marsh-type vegetation.

Restoration of four minor tributaries associated with larger undisturbed stream systems including swamp-type

vegetation.

Each of these restoration projects is discussed separately below.

East Fork Manatee River : Approximately 4,000 feet of the East Fork of the Manatee River is proposed for mining. The restoration plan includes the preparation of a new stream channel and floodplain approximately three years prior to disturbance of the existing stream. This will allow the transplanted and seeded vegetation to become established prior to stream diversion into the artificial floodplain.

In Years 1 and 2 of mining, a double spoil pit will be created adjacent to the 200 acre excavated lake (Figure 5.1-1). The spoil piles will be graded into the pit to create an area with the same elevation and gradient as the existing floodplain. This will require detailed surveying of the existing floodplain and channel prior to its disturbance. As with the original stream, the recreated floodplain will slope more sharply as the channel itself is approached. A "high water" channel roughly 40 feet wide will be constructed in this manner. A low water channel will be excavated in a meandering fashion around alternate obstructions as shown in Figure 5.1-2. This will, in effect, locate the obstructions on the point bar side of the meanders and will serve to stabilize this part of the channel and maintain the original channel length.

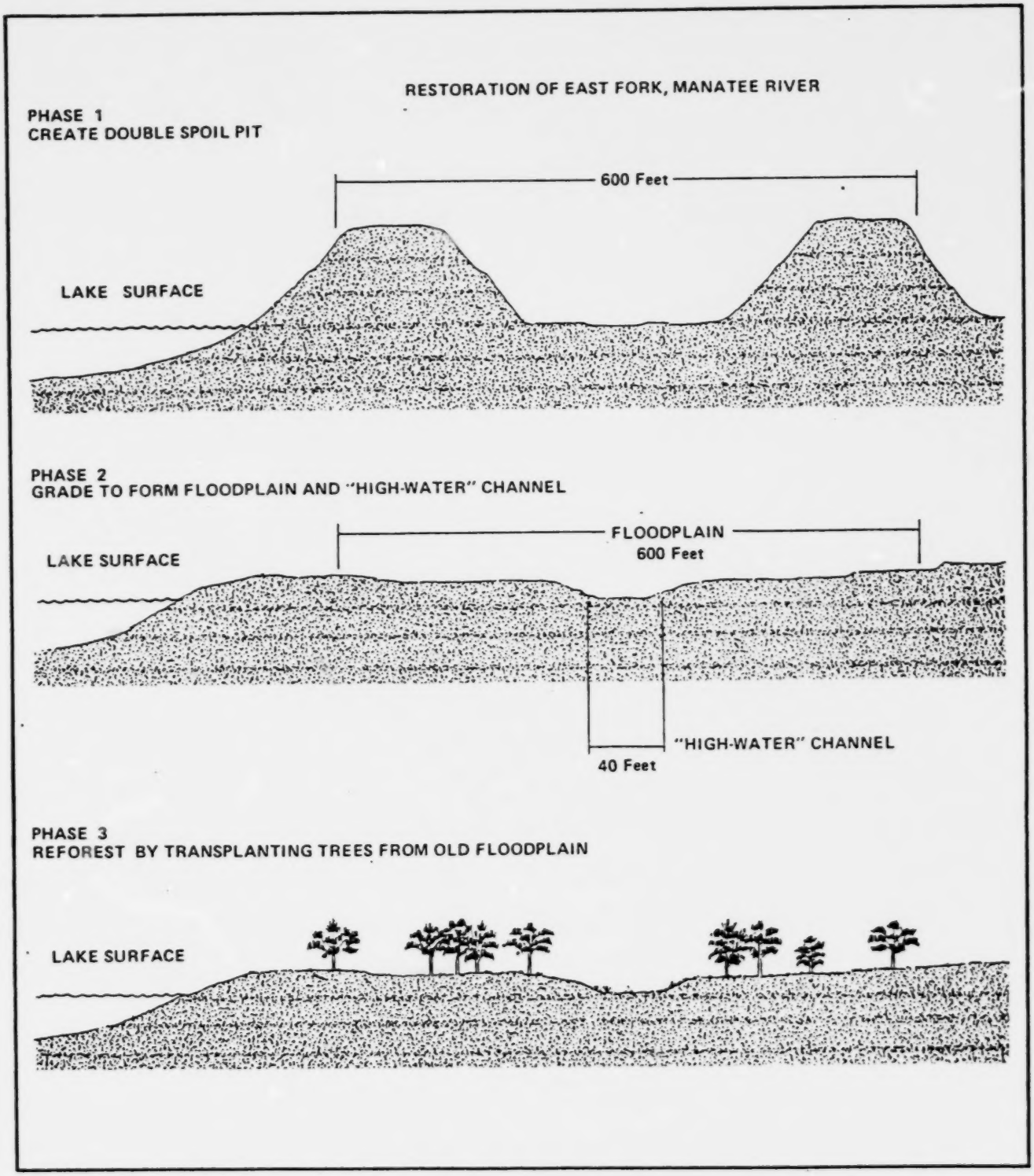

FIGURE 5.1-1

RIVER RESTORATION

Source: Milo Smith + Associates, Inc.
Zellars-Williams, Inc.

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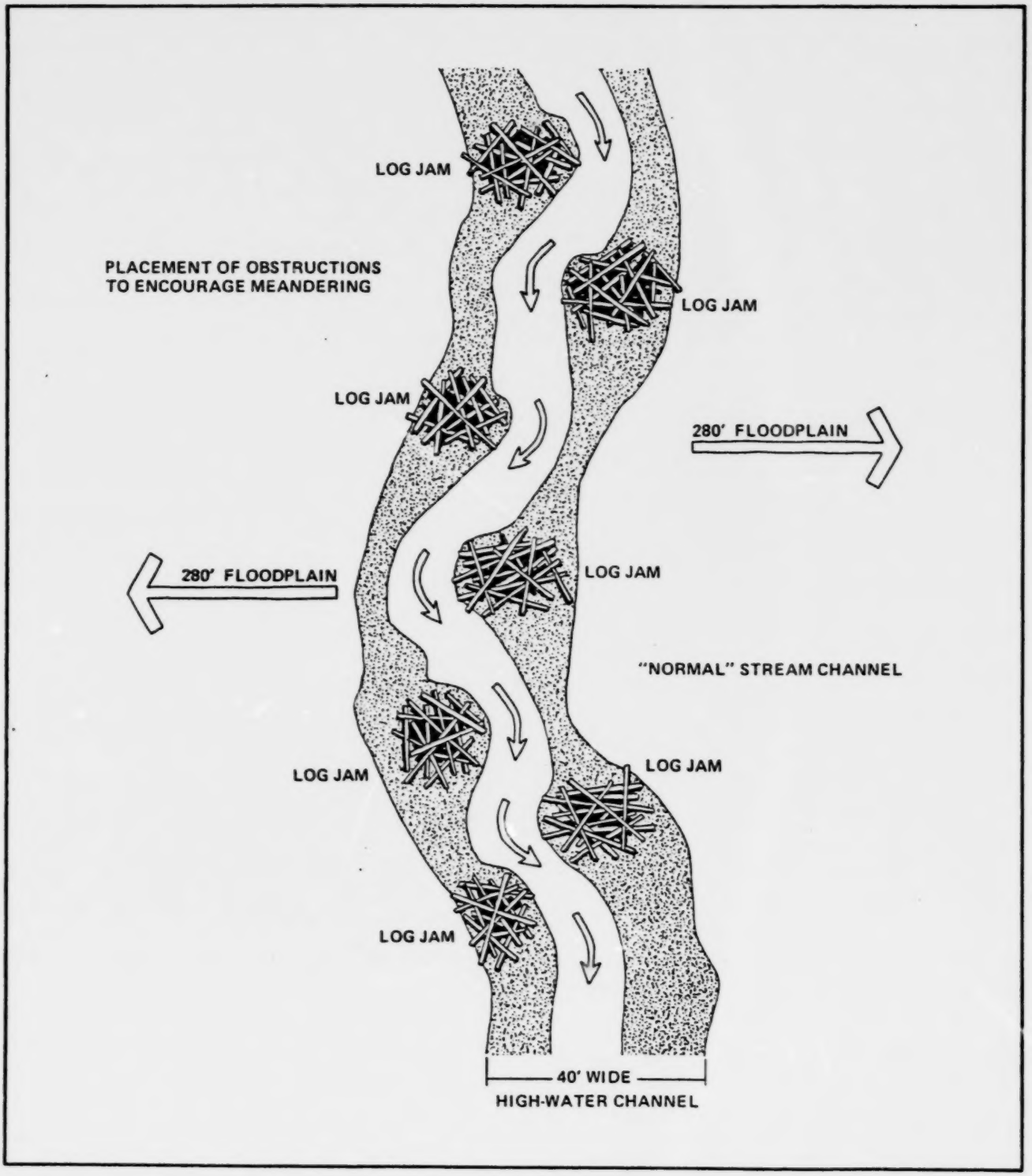

FIGURE 5.1-2

EXCAVATION OF A LOW WATER CHANNEL

Source: Zellars-Williams, Inc.
Milo Smith + Associates, Inc

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Vegetating the created stream system will be completed in two phases. Immediately upon completion of the physical restructuring, the floodplain and high water channel will be planted in grasses and legumes to stabilize the soil and prevent erosion. When the grass cover is firmly estabished, the second phase of vegetation restoration will consist of tree plantings. Tree plantings will be made within the entire restructured floodplain, including the high water channel, down to the low water stream channel (Figure 5.1-3). Trees of 2-4 inches in diameter will be transplanted from the parallel, natural floodplain. Like the natural floodplain, the created floodplain will show a gradation from a hydric environment in the high water channel to an increasingly mesic environment up the slope of the floodplain. Hydric species such as pop ash, sweetbay, and water oak will be emphasized in the lower portions of the floodplain. Plantings will be made at a density of 60 trees per acre. Since diversion of the creek is not planned until year six of mining, the transplanted trees will have two to three years to establish themselves before water is introduced into the new floodplain. It is also expected that during this period, additional native ground cover vegetation will pioneer in the floodplain. Seed sources will be available from the adjacent natural floodplain forest and the vines, shrubs, etc. brought in around the bases of the transplanted trees. Once the flow of the natural stream course is diverted into the recreated system, the relative soil moisture/water level regime is expected to change significantly within the recreated system. The grasses and legumes established in the initial phase of vegetative

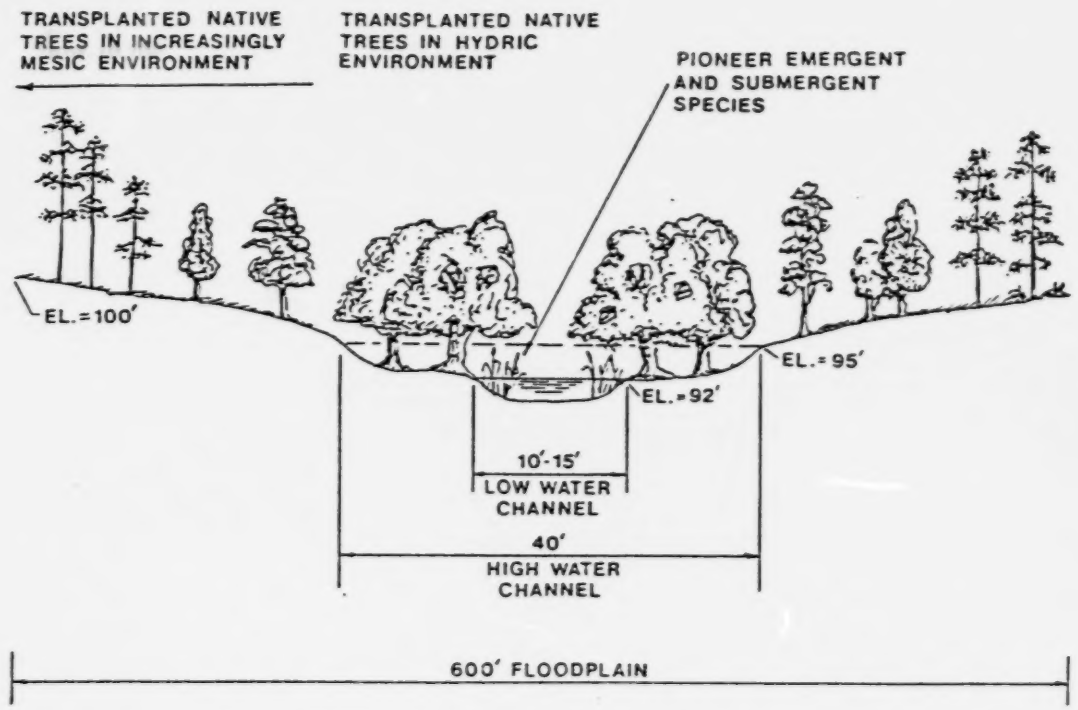

FIGURE 5.1-3

CROSS SECTION OF RESTORED FLOOD PLAIN

Source: Milo Smith + Associates, Inc.

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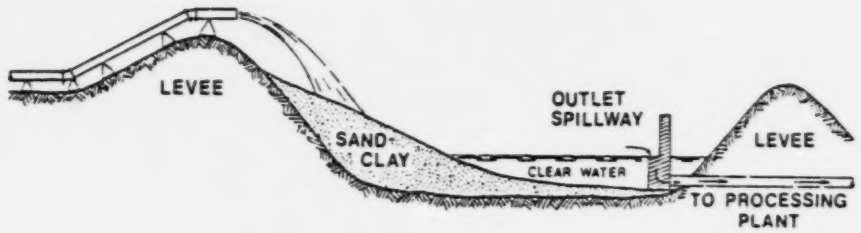
stabilization are expected to be gradually replaced with more moisture tolerant ground cover species in areas that are moist to wet.

Marsh Establishment : Created marshland will be of two types: 1) shallow marshes formed in sand-clay landfills and; 2) deeper marshes formed along the edges of reclamation lakes (Figure 5.1-4).

Sand-Clay Marshes - Sand-clay mix landfills will be the predominant method of physical restoration utilized in reclamation. Drainage through a series of adjacent sand-clay landfills is an important consideration of the overall drainage plan. Figure 5.1-5 shows how adjacent sand-clay landfills will interface and how drainage through these areas will occur. Due to the tendency of fine particles to settle more slowly than coarse particles, all sand-clay landfills are expected to exhibit progressively greater subsidence towards their outlet ends. It will also result in a very gradual slope towards the outlet end where the shallow marshes will be located. Hence all drainage within a sand-clay landfill will be naturally directed toward the artificial marshes.

Water levels in the artificial marshes will be established by the level of the outfall grade. When the retention capacity of the marshes is exceeded, water will exit the areas via drainage swales excavated in the retaining levees. These drainage swales will interconnect the created marshes in adjacent

A - FILLING OF SAND-CLAY AREA SHOWING TYPICAL BASIN FORMATION AROUND OUTLET SPILLWAY



B - RECLAIMED SAND-CLAY LANDFILL SHOWING MARSH FORMATION AT DISCHARGE END

C - CREATION OF MARSHES AROUND LAKE EDGES

FIGURE 5.1-4 (A) (B) (C)

MARSH RESTORATION

Source: Jellars + Williams, Inc

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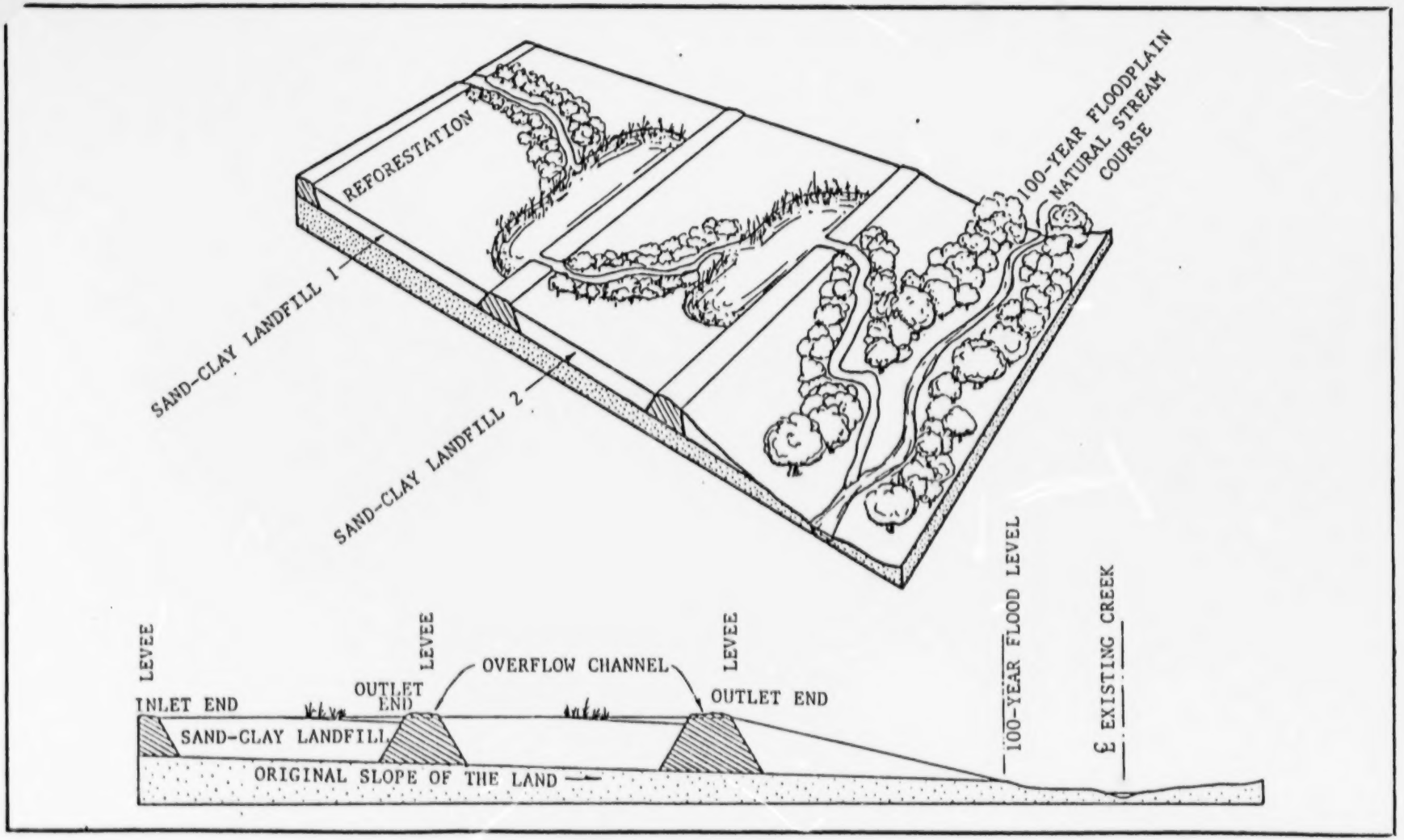

FIGURE 5.1-5 DRAINAGE SYSTEM THROUGH ADJACENT SAND-CLAY LANDFILLS	U.S. EPA-REGION IV DRAFT ENVIRONMENTAL IMAPCT STATEMENT FOR SWIFT AGRICULTURAL CHEMICAL CORPORATION PROPOSED DUETTE MINE MANATEE COUNTY, FLORIDA

sand-clay landfills. As shown in Figure 5.1-6, drainage water exiting one sand-clay landfill will enter the downslope landfill and be conveyed via a drainage swale to the next marsh. This process will continue until one of the natural stream channels draining the site is encountered. At the final artificial marsh in the system, the retaining levee will be sloped gradually to the floodpain below and a broad tamped weir will be constructed to control the water level in the marsh. Overflow from this marsh will be conveyed down the slope via a drainage swale to the natural watercourse below (Figures 5.1-5 and 5.1-6).The entire drainage swale/restored marsh system through sand-clay landfills will therefore be directly integrated with the natural drainage courses on the site.

All drainage swales will be designed with wide cross sections and gradual side slopes. Design capacity for each swale will be based on the size of the drainage basin for the particular swale. In general, this will necessitate the construction of broader swales as the outlet to the natural stream is approached.

Since the final sand-clay landfill and created marsh will be at a slightly higher elevation than the adjacent floodplain, the marsh will not be within the defined floodplain of the natural stream. This design is necessary to allow the maintenace of a water level in the final marsh. The drainage swale and marsh system will, however, be tributaries of the natural stream systems.

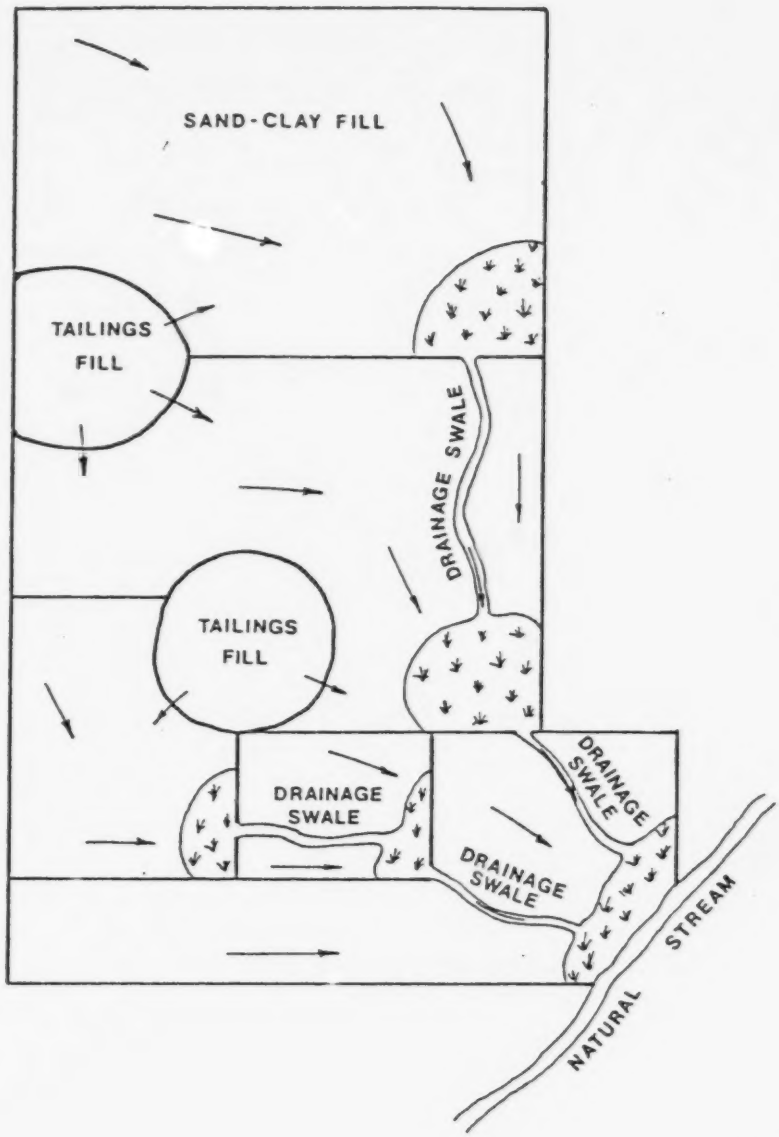

FIGURE 5.1-6

CONCEPTUAL DRAINAGE PATTERN

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The shallow depressions in sand-clay landfills will have gently sloping banks to a wet season depth not expected to exceed six feet. These areas are expected to be quite variable in size and may range in water regime from intermittently wet to permanently inundated. After a period of consolidation, the establishment of a stabilizing vegetative cover on each sand-clay landfill will proceed using standard tillage and grassing techniques. Revegetation with grasses and legumes will proceed to the low water edge of each depression or to the point where the soil is sufficiently wet to inhibit the use of tillage machinery. No specific effort to establish a vegetative cover within the permanently wet area of the depressions is proposed or anticipated as necessary. It is fully expected that natural revegetation with native marsh plants will occur in the depressions as has been repeatedly demonstrated in wetland environments which were created inadvertently or by design following strip mining in Central Florida. The selection/survival of native species within each depression will be a natural function of the proximity of seed/propagule sources and of the specific site conditions such as substrate and water level fluctuations. As each depression will be on the down-flow end of the sand-clay fill area, surface runoff is expected to provide the water necessary to sustain the wetland vegetation that establishes within each depression.

No structural drainage controls are anticipated as part of the final reclamation plan. However, if the final design of any

segment of the reclamation plan includes a structural control, this control will require the approval of Manatee County before it can be constructed. As long as Swift owns the property, it will be responsible for maintenance of any permitted control structures. If the property is sold or transferred to another owner, the new owner will become responsible for the maintenance of such structures.

Lake Edge Marshes - Areas amenable to establishment of freshwater marsh will be created along selected areas of lake shoreline. Beginning at water's edge, grading will establish a slope of 12 to 1 extending to a depth of 6 feet where steeper slopes will begin (Figure 5.1-4). Similar shallow areas will be created around the spoil islands left in the lakes. These areas are estimated to cover approximately 20 percent, or 90 acres within created lakes. These littoral zone marshes are anticipated to provide habitat for species vital to a balanced lake environment.

Upland areas surrounding the lakes will be stabilized using standard tillage and grassing techniques. Natural establishment of wetland vegetation within the littoral zone is expected to proceed as previously described for the shallow depression marshes in sand-clay landfills.

Technology is now evolving on vegetative manipulation for the restoration of wetland environments. If native wetland vegetation does not naturally establish in the created shallow depressions and/or lake littoral zones or an undersireable

wetland community evolves, Swift has committed to the use of state-of the-art technology for the establishment of desireable wetland vegetation on the Duette Mine site.

Minor Tributaries : During reclamation, all swales will be planted in grasses to prevent erosion and turbid runoff. Drainage swales intended to replace existing forested drainage courses will be planted in hydric and mesic forest species. Figure 5.1-7 shows the four drainage courses proposed for reforestation.

Reforestation of minor tributaries will be accomplished by planting potted and bare-root seedlings at a density of approximatel 100 trees per acre. Water oak, laurel oak, red maple, sweetgum, blackgum, carolina ash, and slash pine will be included in the plantings.

Included in the reforestation plans are the swales which replace the minor tributaries to the North Fork Manatee River (areas 3 and 4 Figure 5.1-7), and the tributary to the East Fork Manatee River (area 1 Figure 5.1-7). In addition, reforestation is planned for the drainage area between the created mine reservoir and an adjacent fresh water marsh (area 2, Figure 5.1-7). Acreage involved in these four wetland reforestation areas is given below:

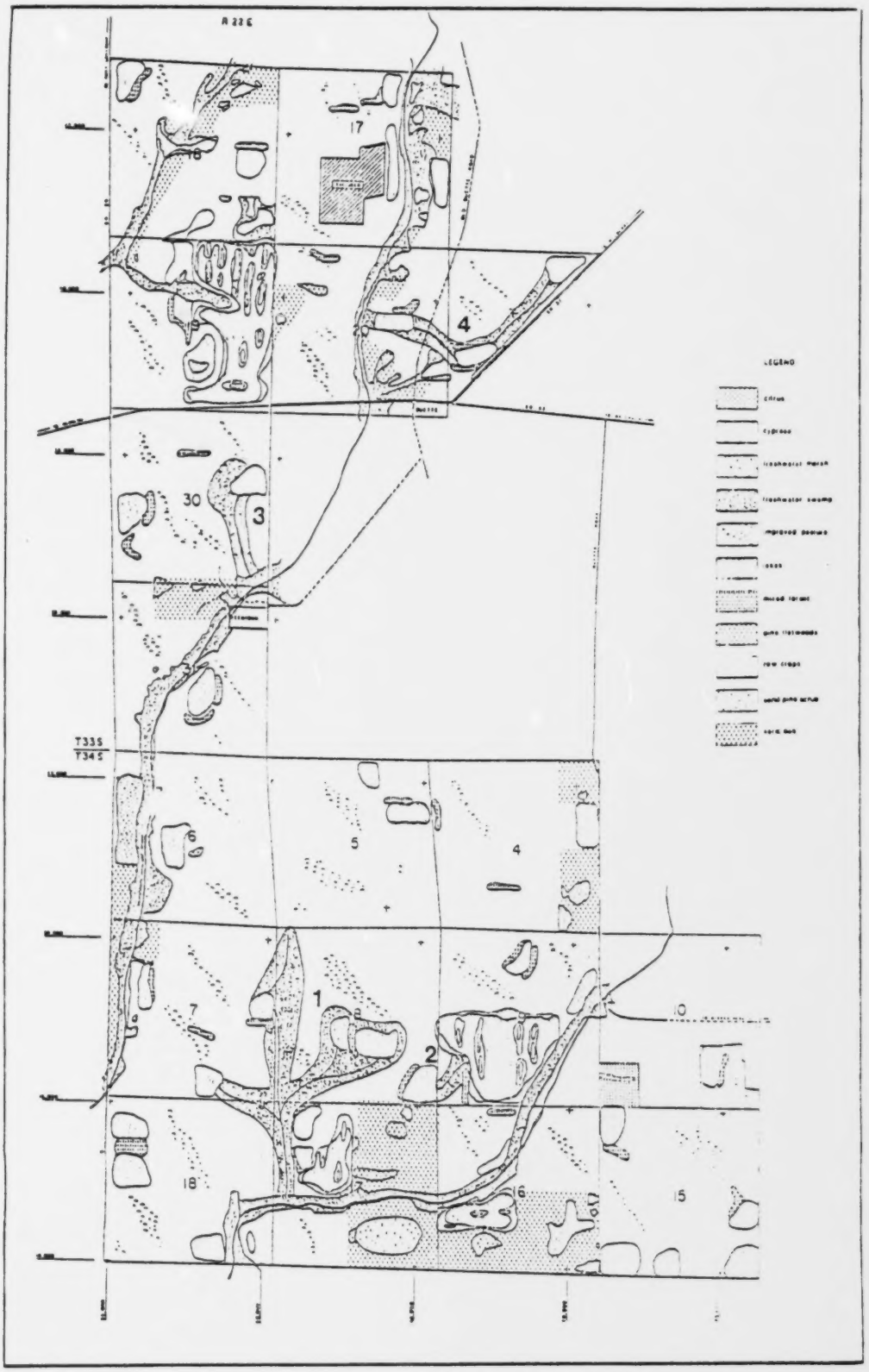

FIGURE 5.1-7

RESTORATION OF FORESTED DRAINAGE SWALES

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Area	Acreage
1	284
2	22
3	51
4	73
Total	430

This restored forested wetland acreage along with the 55 acres of forested wetland restored along the East Fork Manatee River will exceed the 476 acres of forested wetland disturbed by the mining operation.

5.2 Lake Creation

Five lakes are proposed in the Swift reclamation plan. All lakes are designed to be hydrologically integrated within the site drainage plan.

Lake outfalls, except for the mine reservoir, (Section 9, Figure 5.1-7) will consist of vegetated, tamped earthen berms located at the lake side closest to natural streams. The berm width will be designed so that the discharge velocity during a 100 year, 24-hour storm will not exceed 2 feet/second. The weir for the mine reservoir (Section 9) will have a concrete lining to prevent downcutting as a result of withdrawals from the East Fork Manatee River during operation of the mine. At high water, drainage water exiting the lakes will be conveyed via drainage swale to the nearest natural floodplain and stream channel.

The lake in Section 5 has a surface area of 36 acres and a total

watershed area of 143 acres. This small lake will have served as the plant clear water pool during the active phase of the operation. After reclamation, the lake will have a design water surface elevation of 118 feet(MSL). During a normal year, the water level of this lake should not fluctuate by more than one foot. Prolonged drought may cause the water level to drop as much as three feet.

The lake in Section 9 has a surface area of 145 acres and a total watershed area of 732 acres. The design water surface elevation for this lake has not yet been established. However, after reclamation, this lake is not expected to fluctuate from the wet to dry season during an average year by more than one foot. During a prolonged drought, the water level may drop by as much as three feet.

The lakes in Section 16 and 17 have surface areas of 120 acres and 114 acres, respectively. Both lakes have a design water elevation of 95 feet (MSL). During the summer months of an average year, the water levels will remain at, or slightly above, the design elevation. During the remainder of the year, the water level may decrease as much as one foot. As in the case of the other lakes, prolonged drought may cause the water levels to drop by as much as three feet.

The lake in the northwest portion of the property (Section 19) adjoins the designated wilderness area. The entire lake system has a surface area of 217 acres with a watershed of 523 acres.

Design water surface elevation of this lake system is 115 feet (MSL). From June through September during an average year, the lake should remain at, or slightly above, the design elevation. From October through May during an average year, the lake level will decrease to approximately elevation 114 feet (MSL). The lake system is bordered on the west by a preserved segment of floodplain forest, the preserved cypress dome, and two created marshes in sand-clay landfills. Overflow from the lake system, cypress dome, and restored marshes will feed the tributary to the South Fork Little Mantee River. The lake with its surrounding drainage basin forms the major part of the drainage basin for this minor tributary.

Figure 5.2-1 shows a cross section of reclaimed wetland areas and conceptually presents the hydraulic integration of surface water as well as surficial ground water level re-establishment.

A buffer zone consisting of either mixed pine-hardwood forest or deep freshwater marsh will be created around each of the lakes. In the case of mixed forest, the shoreline above the disign water level will be graded to slopes of 7 to 1 or less, the soil stabilized by grassing, and trees planted. In the case of deep freshwater marshes, grading will establish a slope of 12 to 1 below design water level and extend to a water depth of six feet. No marsh zone will be created in the water reservoir adjacent to the plant.

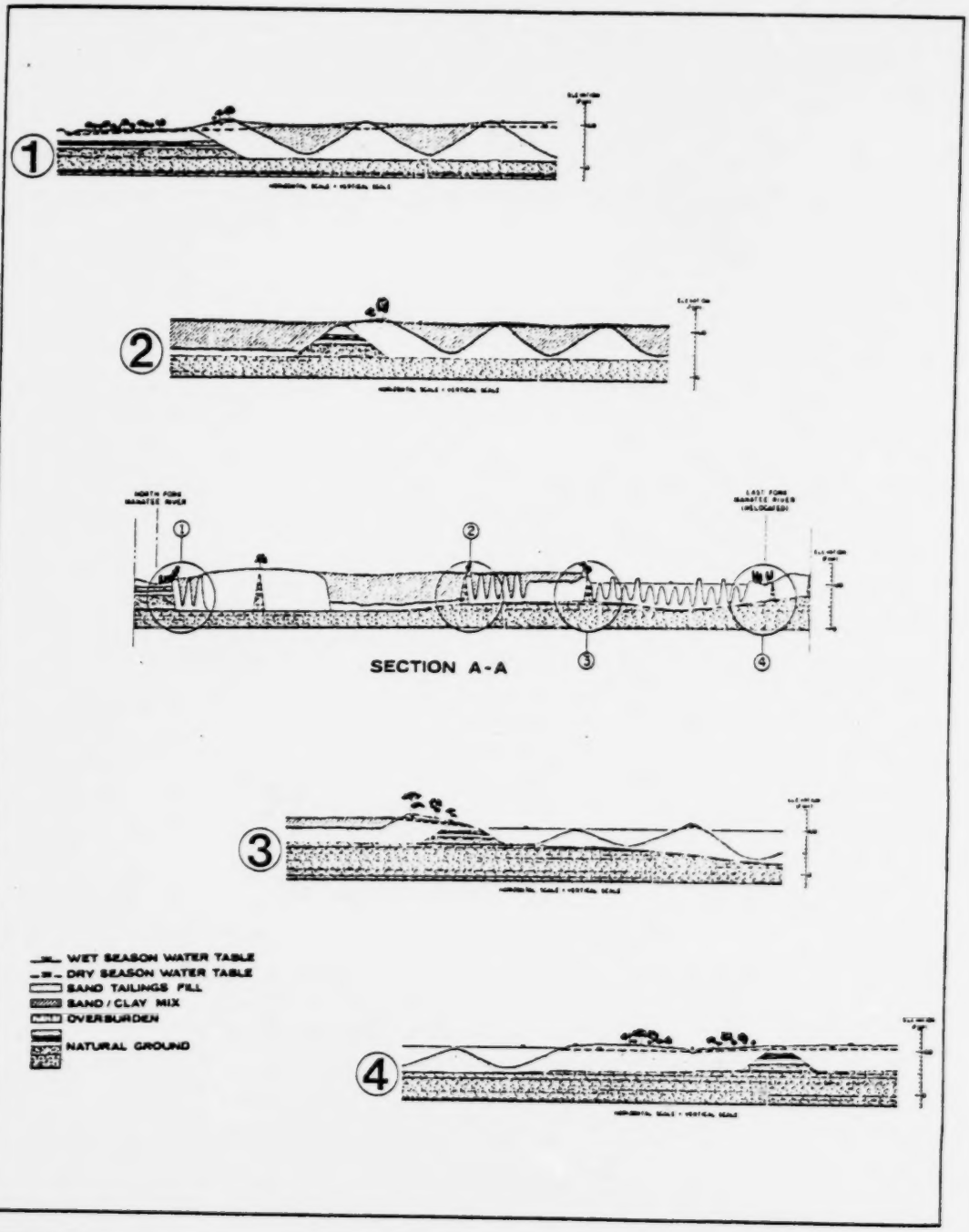

FIGURE 5.2-1

WETLAND RECLAMATION

Source: Ardaman + Associates, Inc.

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5.3 Natural Revegetation

The designated 100-acre wilderness area will be allowed to revegetate naturally. It is expected that the spoil rows will be colonized by various herbaceous species followed within a few years by a heavy brush growth consisting primarily of wax myrtle. Due to the proximity of the South Fork Little Manatee River floodplain to the wilderness area, some eventual colonization by native tree species such as sweetgum, black cherry and water oak is expected.

6. RECLAMATION SEQUENCE

Figures 6-1 through 6-6 show the progressive reclamation of the property throughout the project life. These figures each represent four-year increments in the reclamation sequence and are integrated with the mining sequence (Figure 6-7).

The early years of the reclamation sequence show mining advancing faster than the finished reclamation due to the time lag necessary to complete a reclamation project. The time lag is most apparent in the early years of mine development but is reduced in ensuing years as the excavation and reclamation continues. By mid-project life, mining and reclamation are similar in annual acreage completed. Late in the project life the reclamation advances at a faster rate than the mining. Mining is scheduled to cease in year 21 and all reclamation, with the exception of the clay settling area, will be finished

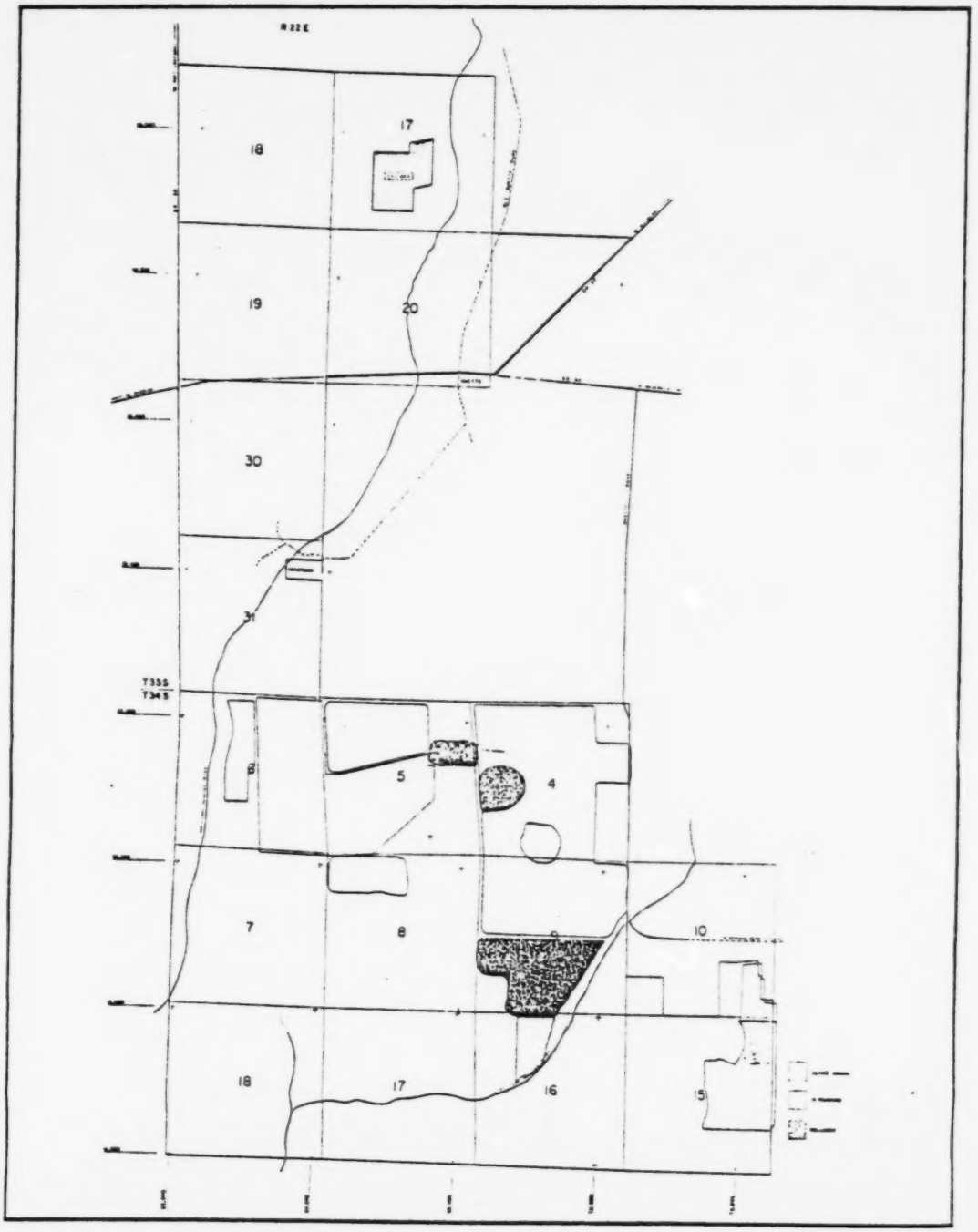

FIGURE 6-1

RECLAMATION SEQUENCE-YEAR 4

Source: Zellars-Williams, Inc.

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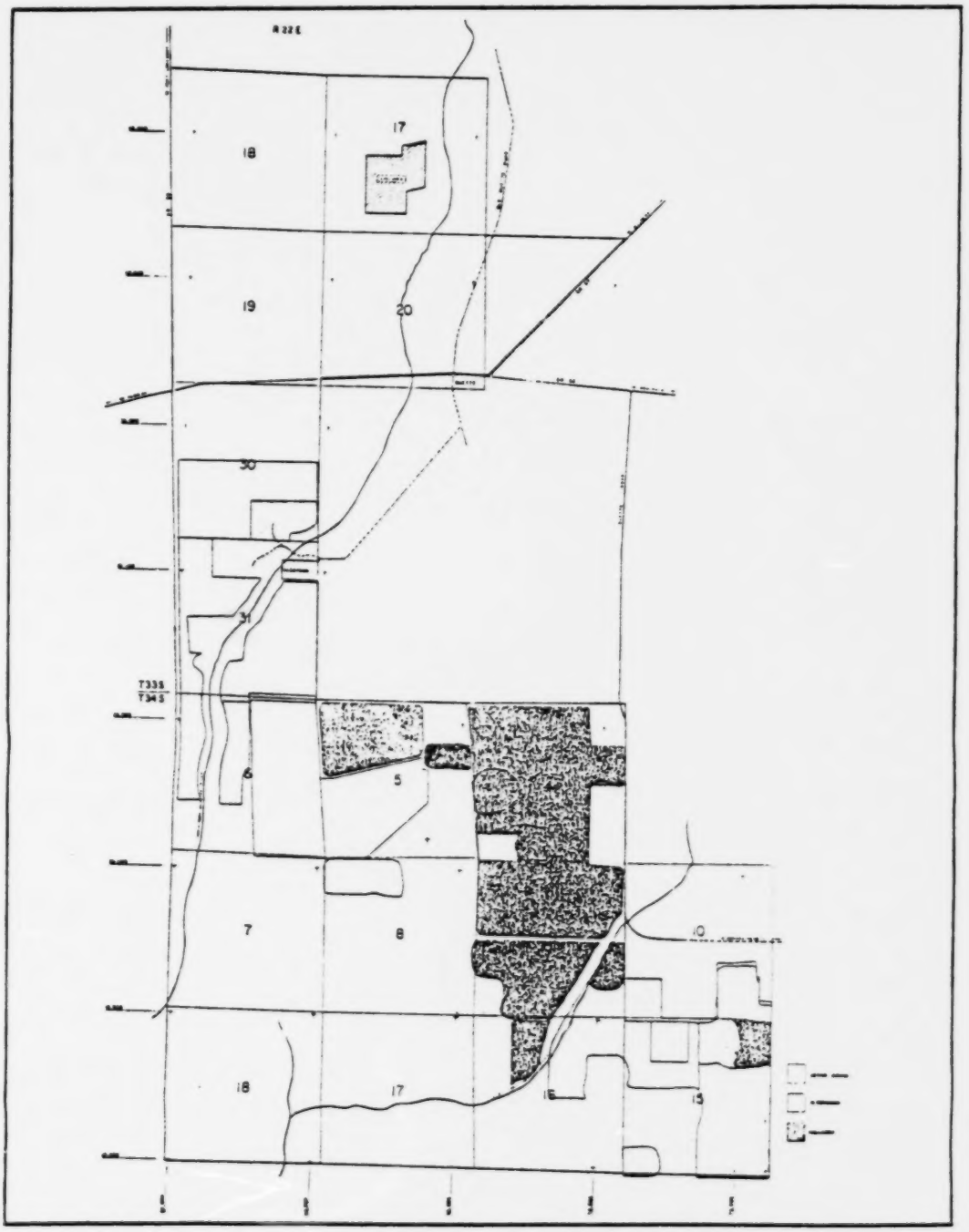

FIGURE 6-2

RECLAMATION SEQUENCE-YEAR 8

Source: Zellars-Williams, Inc.

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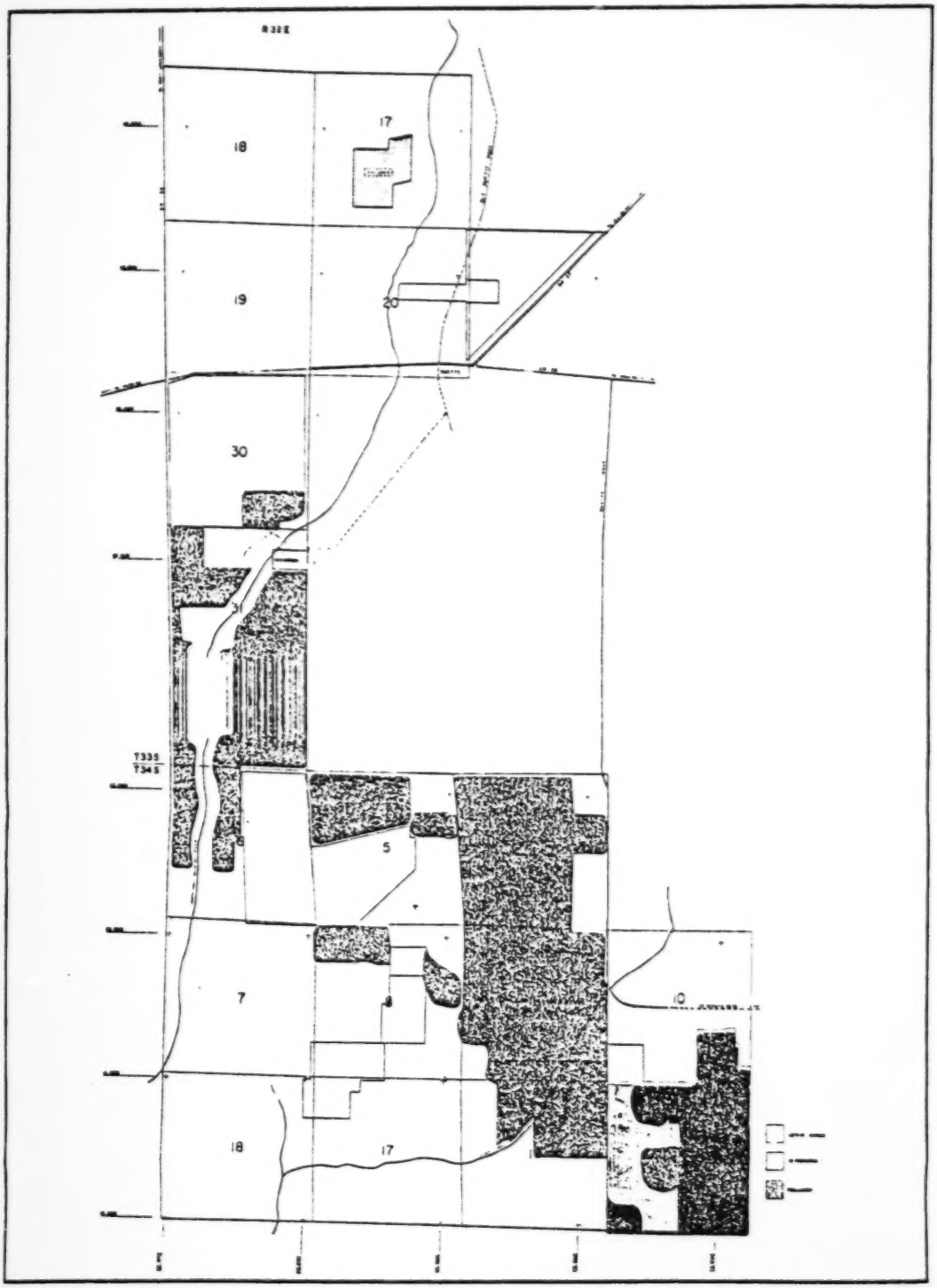

FIGURE 6-3

RECLAMATION SEQUENCE-YEAR 12

Source: Zellars-Williams, Inc.

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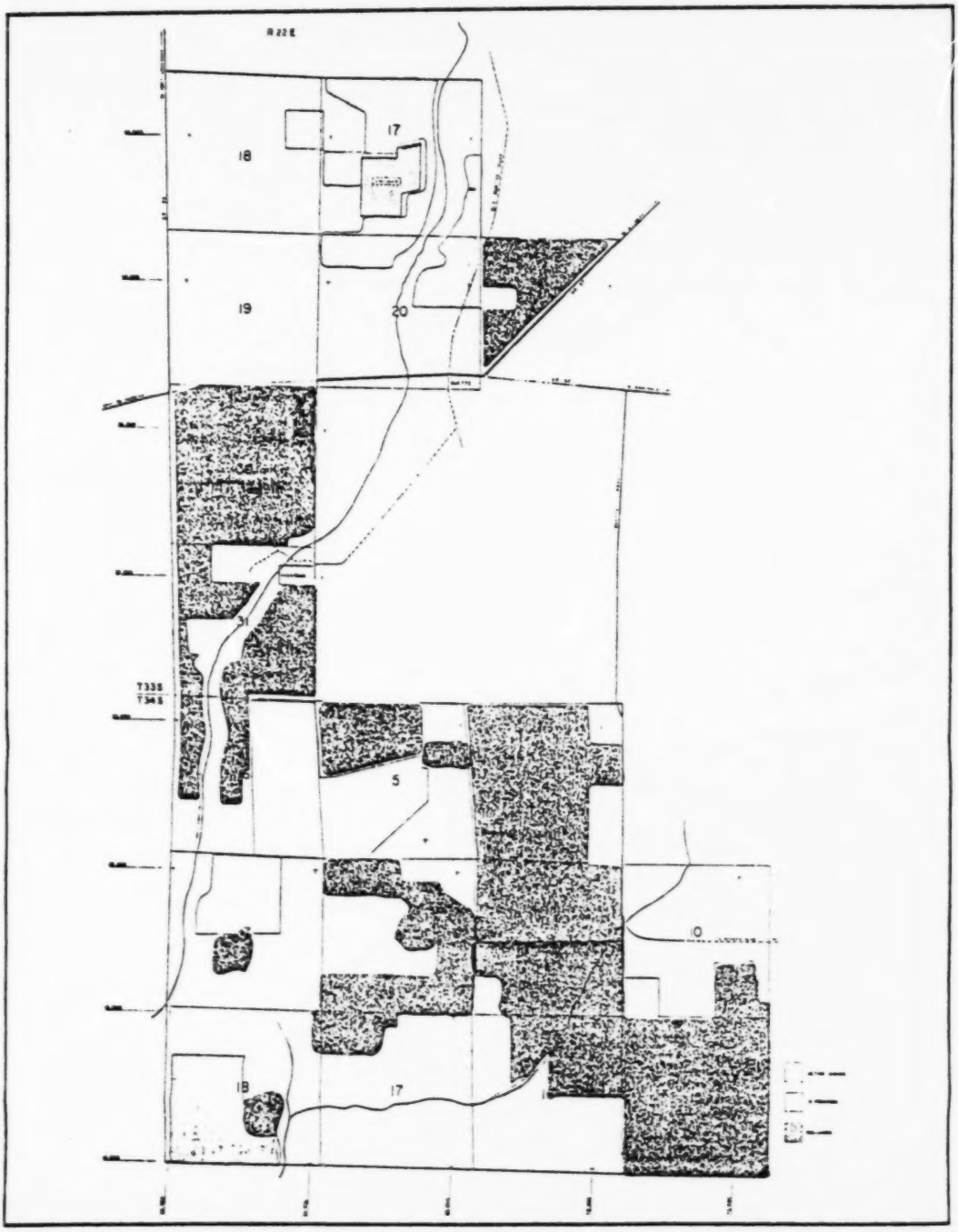

FIGURE 6-4

RECLAMATION SEQUENCE-YEAR 16

Source: Zellars-Williams, Inc.

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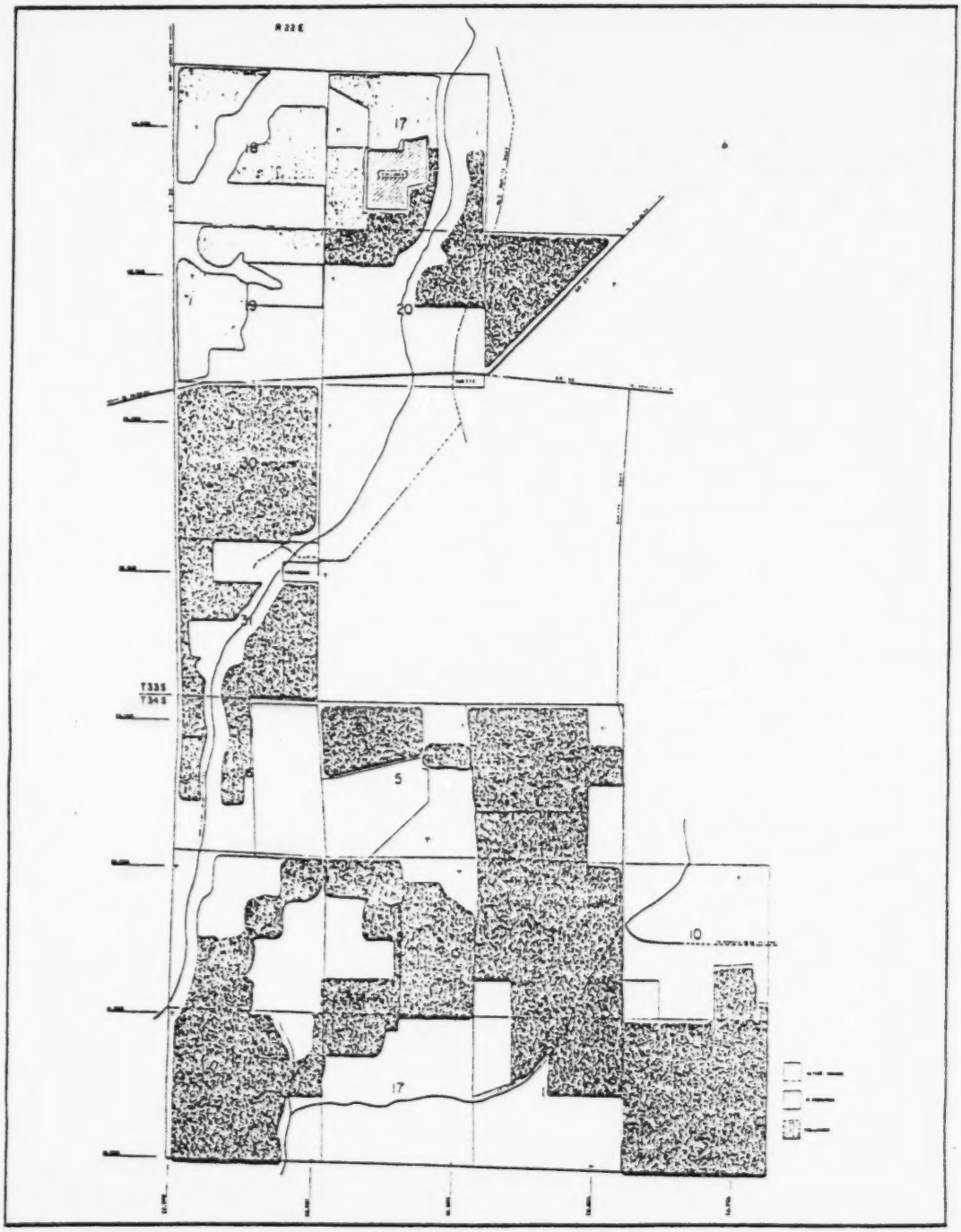

FIGURE 6-5

RECLAMATION SEQUENCE-YEAR 20

Source: Zellars-Williams, Inc.

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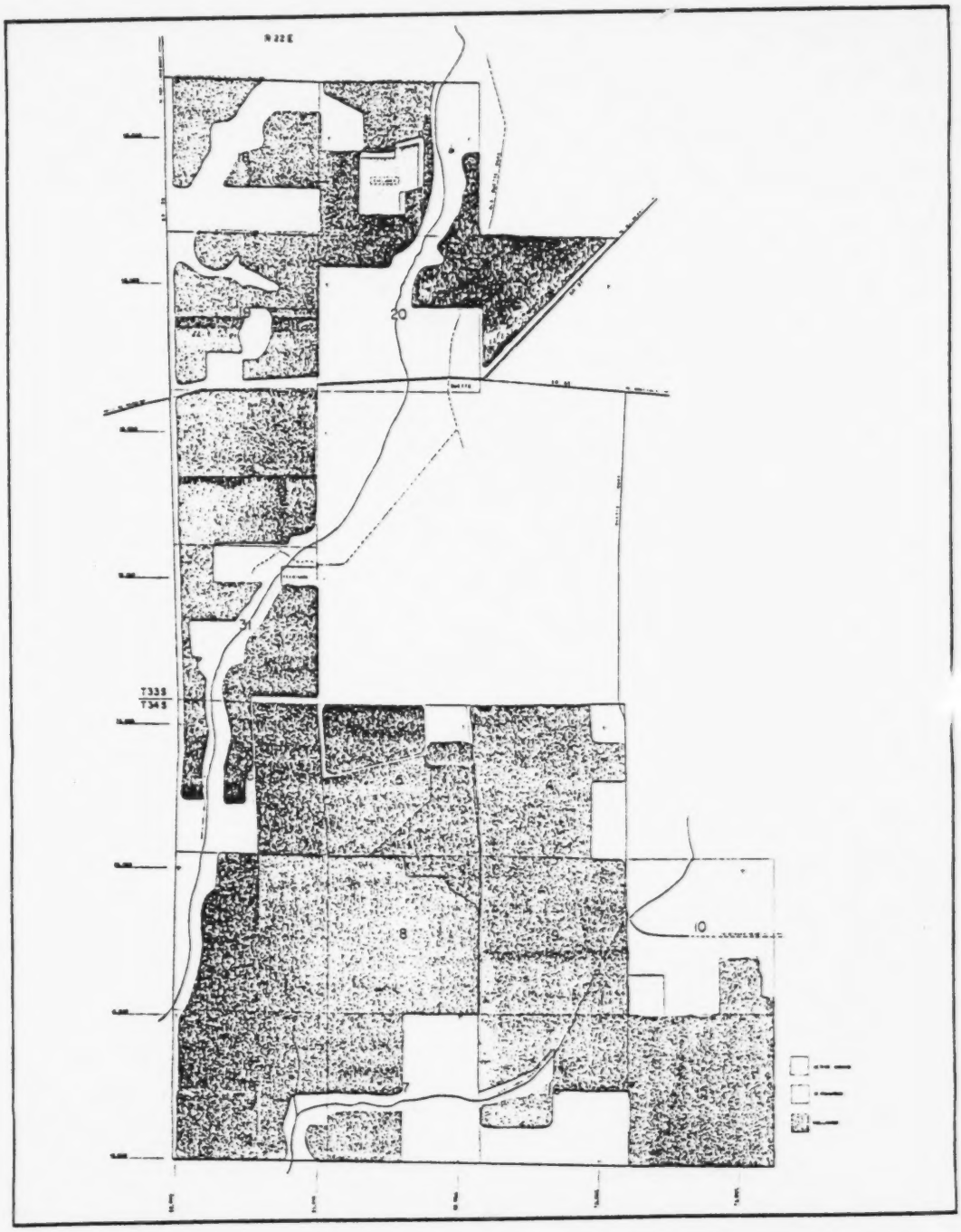

FIGURE 6-6

RECLAMATION SEQUENCE-YEAR FINAL

Source: Zellars-Williams, Inc.

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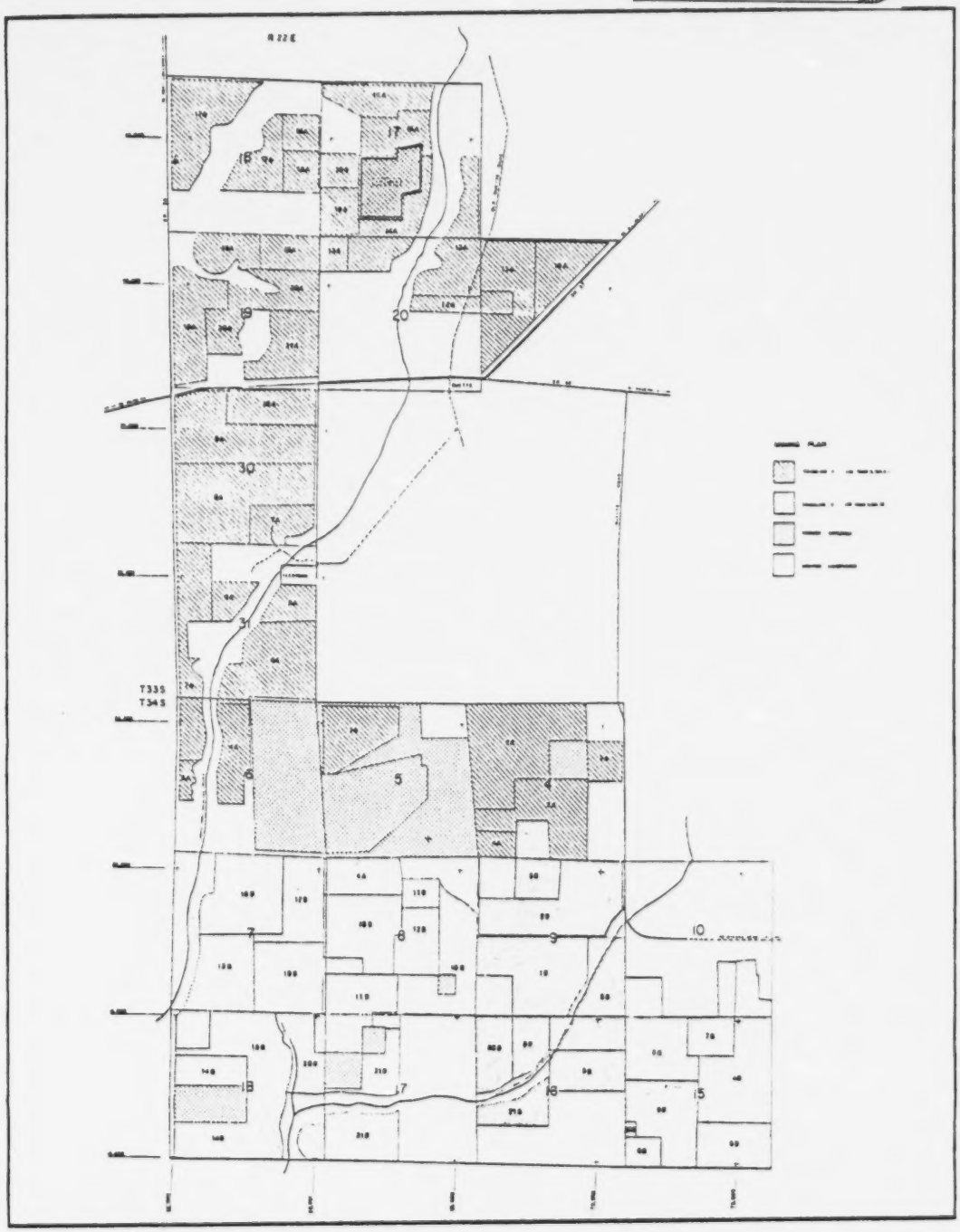

FIGURE 6-7

MINING PLAN

Source: Zellars-Williams, Inc.

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by year 26 of the project life. Within two years after mining has ceased, 84 percent of the disturbed property will be reclaimed. Reclamation of the settling area by year 31 will complete rehabilitation of the site.

7. POST-MINING LAND USE

The primary change in land use resulting from mining and reclamation will be replacement of native range (pine flatwoods) with agriculturally improved land including pasture, cropland, and citrus groves (7,203 acres or 69.3 percent of the site). Improved pasture will account for 7,072 acres of this land. Coniferous forest will occupy 879 acres, most of which will be cut-over pine flatwoods upgraded by half density pine plantings. Other upland forest areas will include 89 acres of undisturbed hardwood forest and 58 acres of mixed forest strands established by reforestation. Forested wetlands will include all the original wetland coniferous forest (cypress) and approximately two-thirds of the original wetland hardwood forest. Nonforested wetland areas (marsh) will have increased over pre-mining levels to 864 acres or 8.3 percent of the total area. Lakes will have been created on 384 acres and a wilderness area of 100 acres. Following is a summary of land use changes.

Table 7-A Land Use Changes

Type	Before Mining Acreage	Before Mining Percentage	After Reclamation Acreage	After Reclamation Percentage
Cropland and Pasture	2,144	20.6	6,748	65.0
Citrus Groves	113	1.1	25	0.2
Coniferous Forest	5,781	55.6	879	8.4
Hardwood Forest	0	5.0	89	0.9
Mixed Forest	0	0	58	0.5
Lakes	0	0	384	4.7
Wetland-Coniferous Forest	18	0.2	18	0.2
Wetland-Hardwood Forest	1,219	11.7	1,228	11.8
Wetland-Vegetated Nonforested	600	5.8	864	8.3
Other (Wilderness area)	0	0	100	1.0

8. PROPERTY BOUNDARY INTEGRATION

Swift's Duette Mine tract is bounded on the northeast by the W. R. Grace & Company Four Corners Mine and on the south and southwest by the Beker Phosphate Company Manatee Mine.

In the Grace reclamation plan, land immediately adjoining the Swift tract is to be reclaimed as land and lakes. The land areas are to be utilized as improved pasture. This improved pasture adjoins reclaimed improved pasture and an undisturbed portion of the North Fork Manatee River on the Swift property. The economic uses of the two reclaimed tracts would appear to be compatible. Both the Swift and Grace plans provide for the preservation of the floodplain of the North Fork Manatee River. The North Fork does not enter the Swift tract directly from the Grace property. Rather it exits the Grace site and flows through adjacent agricultural land for approximately a mile before

entering the Swift tract. The Grace plan also calls for the restoration of a large marsh area adjoining the floodplain of the North Fork. This will compliment the reclaimed and preserved marshes planned for the Swift tract. The marsh and floodplain areas for the two tracts appear well integrated.

The Swift and Beker reclamation plans appear compatible from both the economic and environmental land use standpoints. Improved pasture will be the primary use of reclaimed Beker land adjoining the Swift tract. This pasture lies adjacent to reclaimed pasture and a large tract of pine flatwoods scheduled to be upgraded by half density pine plantings on the Swift property. Two segments of undisturbed pine flatwoods on the Beker site interface similar undisturbed areas on the Swift site.

Both the Swift and Beker plans provide for the maintenance of the North Fork Manatee River floodplain. On the East Fork, Beker has proposed to construct a water impoundment following mining. The Swift plan provides for maintenance of the majority of the floodplain and restoring the one area in which mining is planned.

Figures 8-1 and 8-2 illustrate the land uses for the adjoining Beker and Grace Sites.

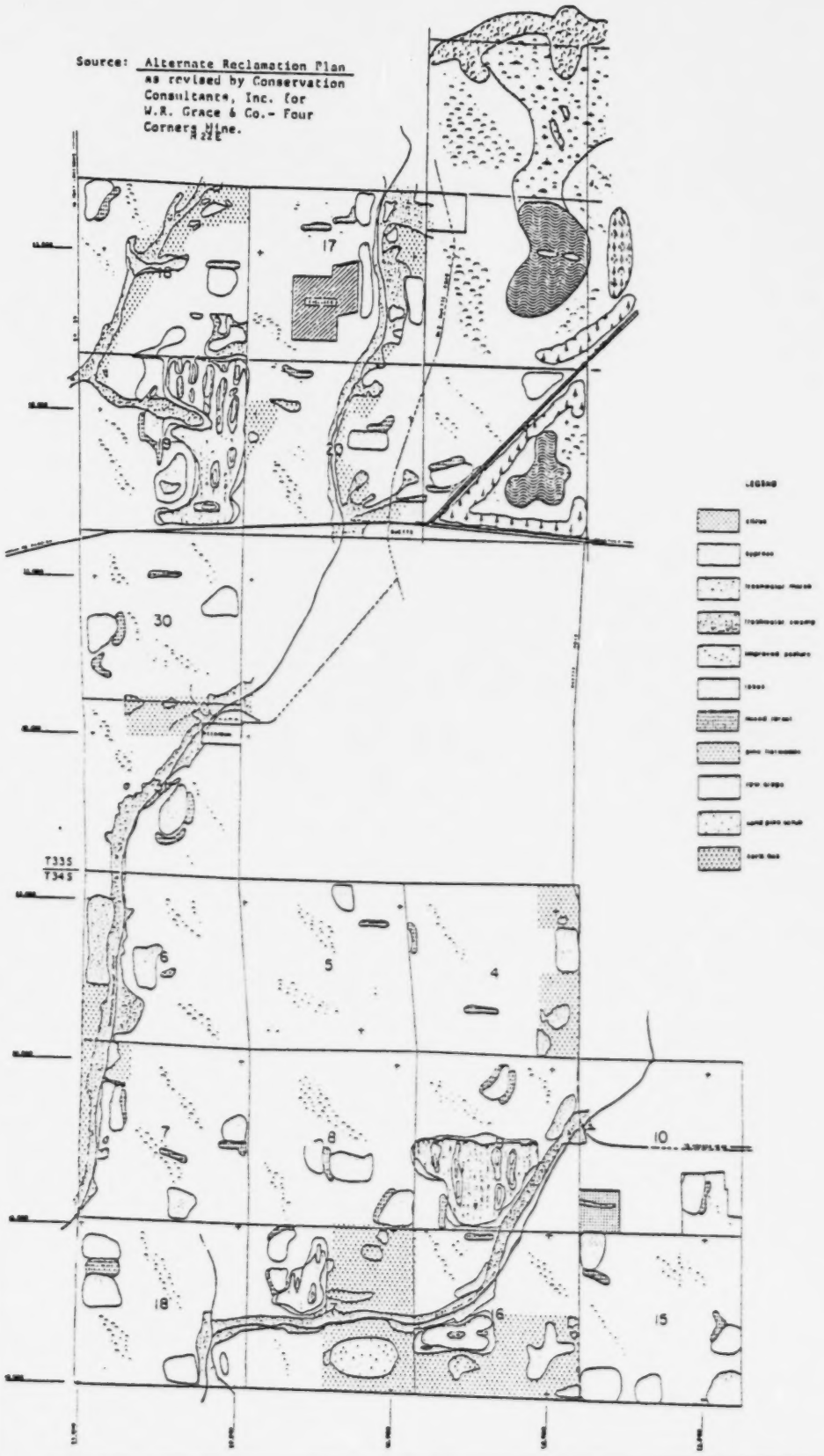

FIGURE 8-1

PROPERTY BOUNDARY INTEGRATION WITH W. R. GRACE & COMPANY

U. S. EPA, REGION IV
DEIS
DUETTE MINE
MANATEE COUNTY, FLORIDA

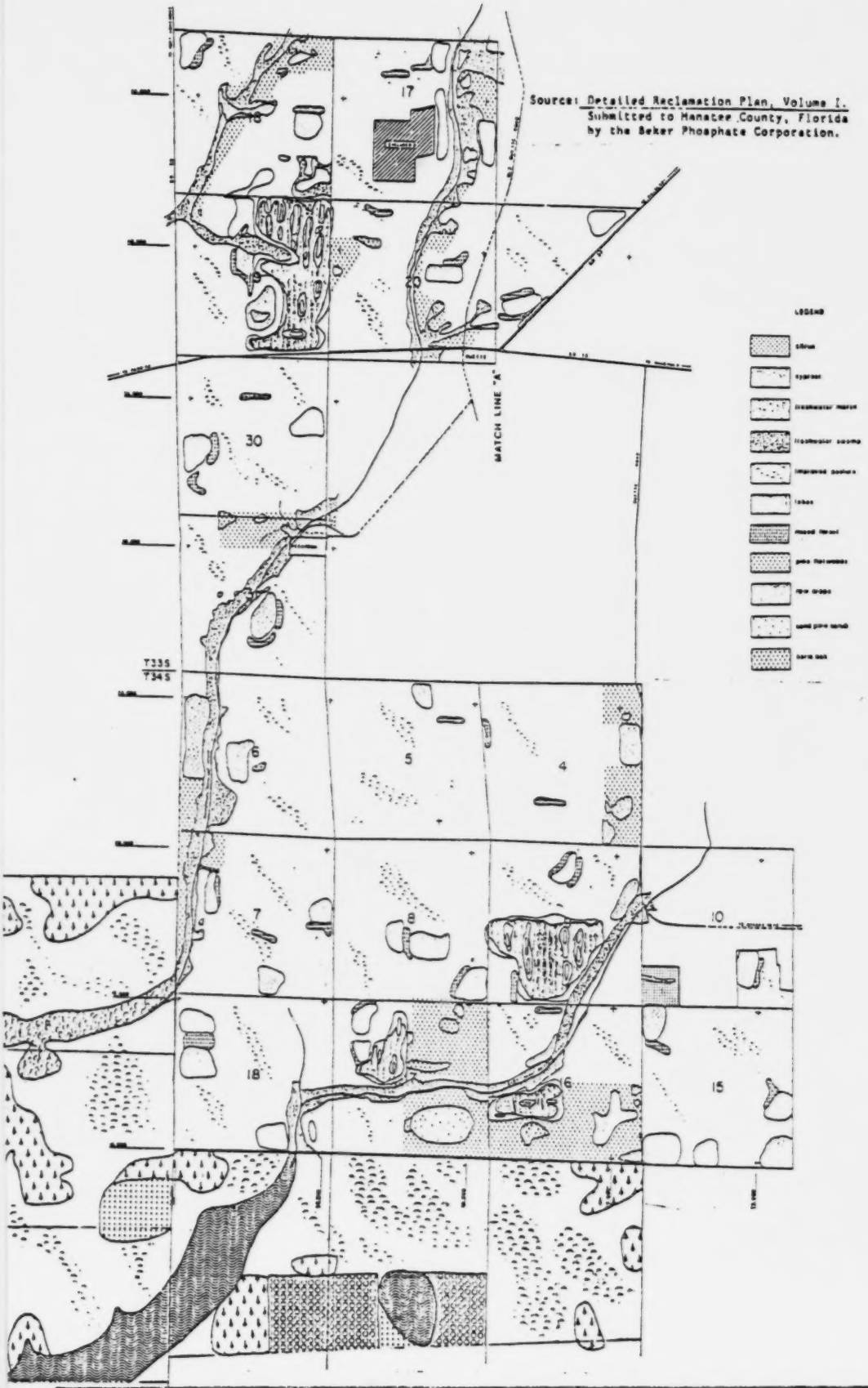

FIGURE 8-2
PROPERTY BOUNDARY INTEGRATION WITH
BEKER PHOSPHATE

U.S. EPA, REGION IV
DEIS
DUETTE MINE
MANATEE COUNTY, FLORIDA